Home STEAM Lab

Book of Toys #3

Flying Toys

For more experiments,
video instructions and
photos, scan the QR.

This book series is inspired by Arvind Gupta's Toys from Trash (www.arvindguptatoys.com), and grew from outreach events hosted by the Bhaktivedanta STEAM School of Excellence (Kanpur) in collaboration with the Indian Institute of Technology Kanpur. Arvind Gupta is a science educator, toy inventor and author. He graduated from IIT Kanpur in 1975 and received the Padma Shree from the Government of India in 2018. This book is prepared by Prof. Kunal Mooley and Kritika Awasthi from IIT Kanpur, and it is meant for educational and outreach purposes only.

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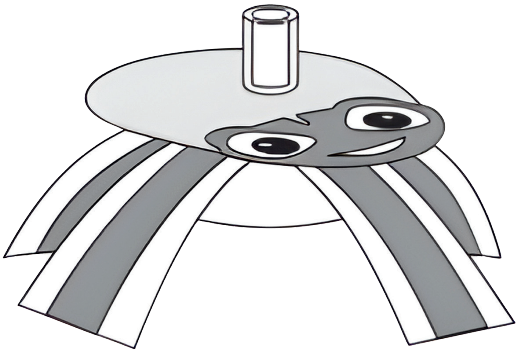

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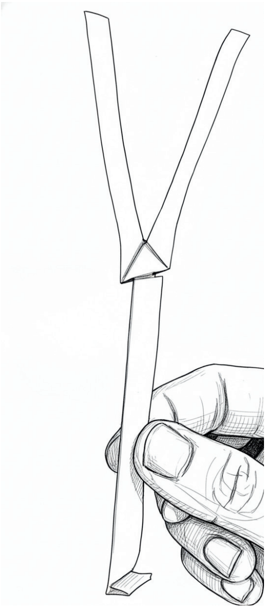
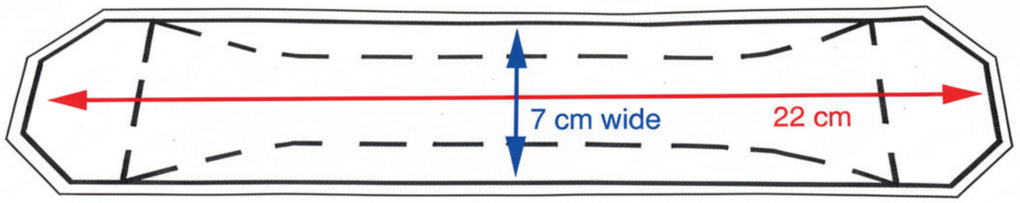
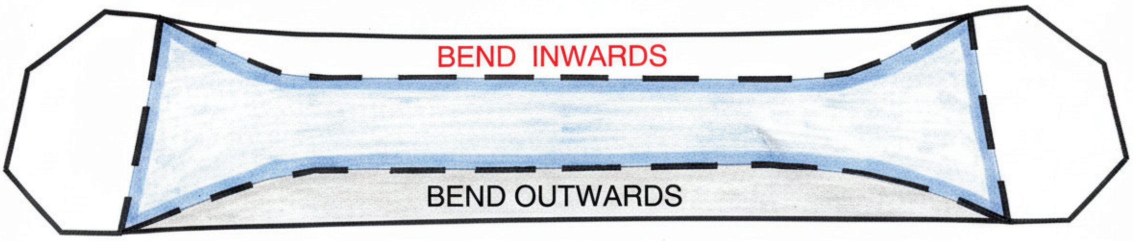
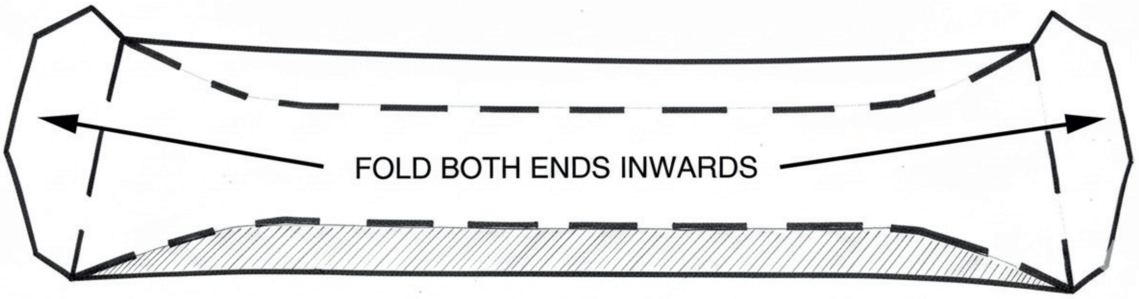


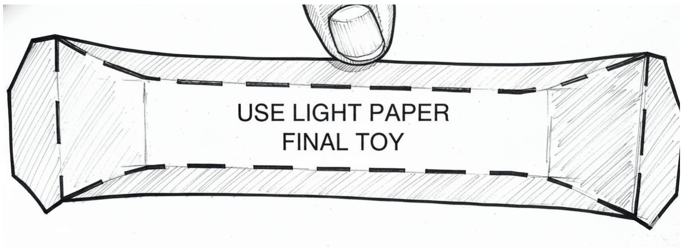
In the spirit of "toys from trash" most of the materials required for the experiments in this book can be found at home. Other items can be easily purchased from a nearby hardware store or online stores like Flipkart or Amazon.in.

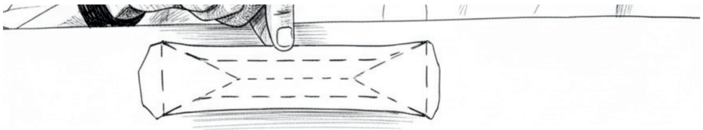
1. AIR SURFING


7 cm wide
22 cm

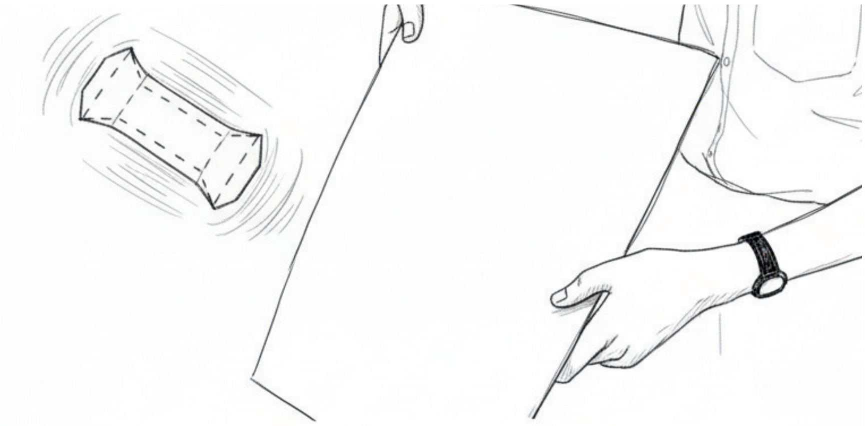

BEND INWARDS
BEND OUTWARDS


FOLD BOTH ENDS INWARDS


USE LIGHT PAPER
FINAL TOY

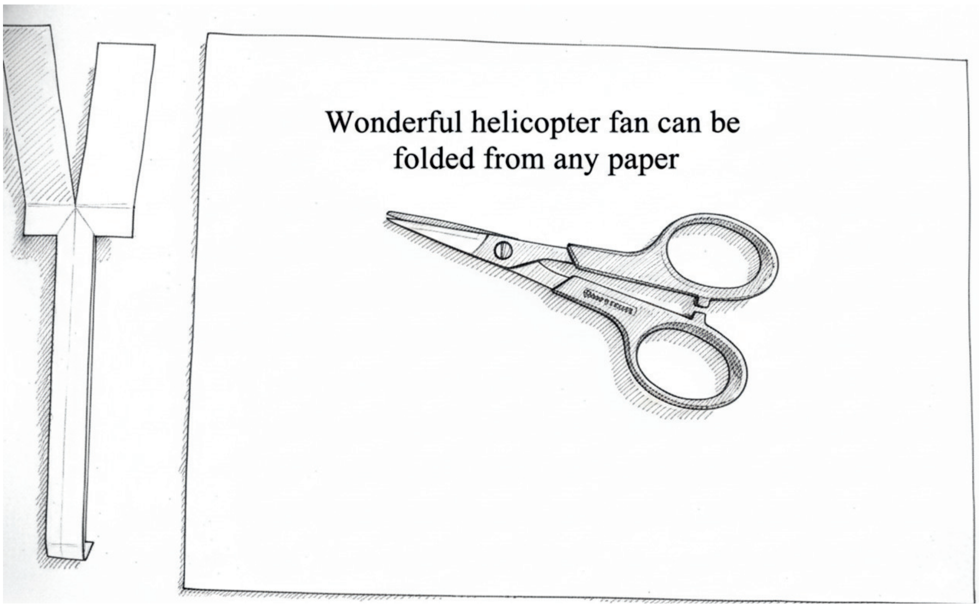


LEAVE TOY IN AIR. HOLD STIFF CARD SHEET 60 CM X 60 CM BELOW TOY AT SLANT AND RUN TO SPIN AND MANIPULATE TOY.

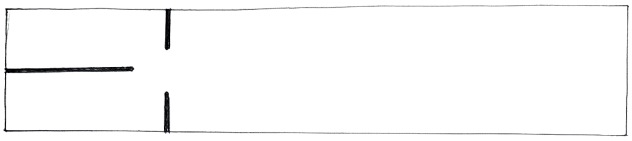


TOY SPINNING & MOVING. SPEED & HEIGHT OF TOY CAN BE CONTROLLED BY CHANGING ANGLE AND SPEED OF CARD SHEET

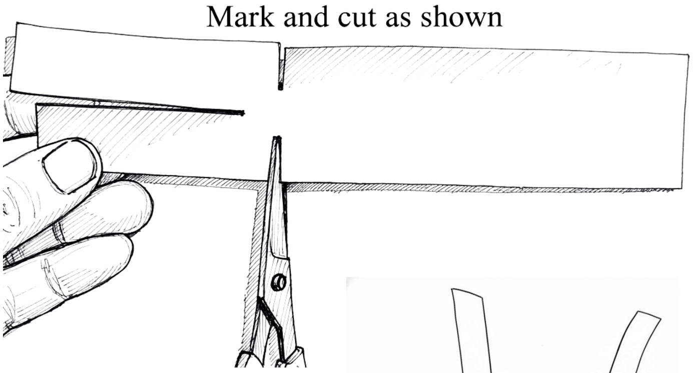
2. PAPER HELICOPTER

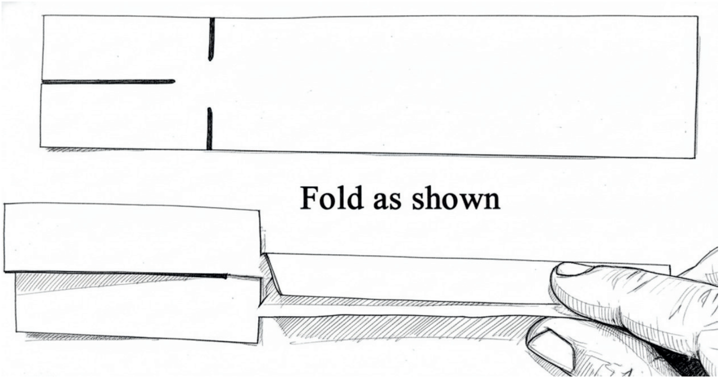


Wonderful helicopter fan can be folded from any paper

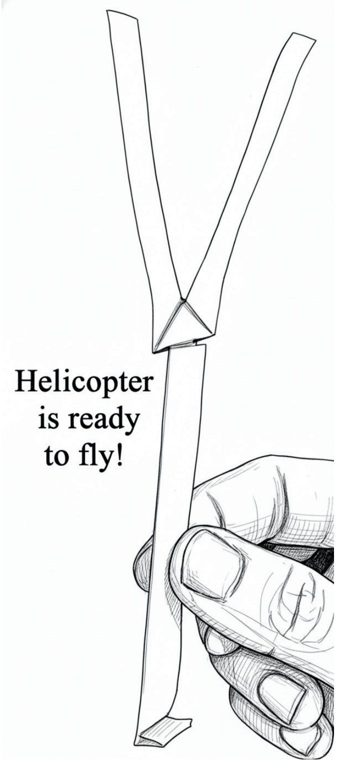


Take a strip of paper around 15cm x 4cm
Mark and cut as shown

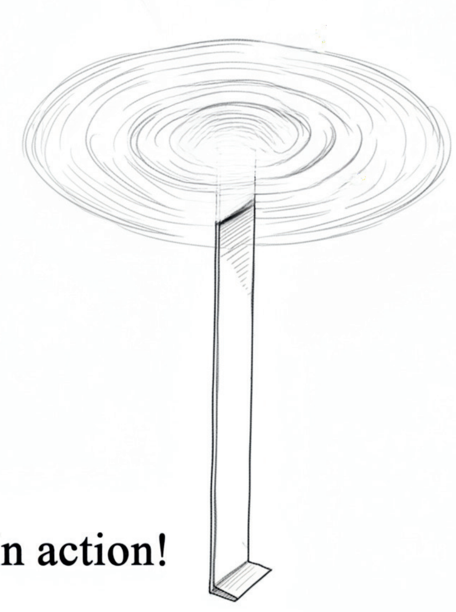




Fold as shown

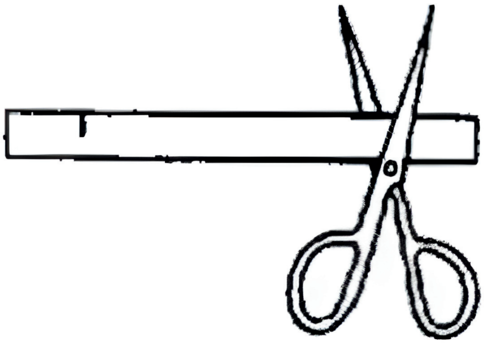


Helicopter
is ready
to fly!

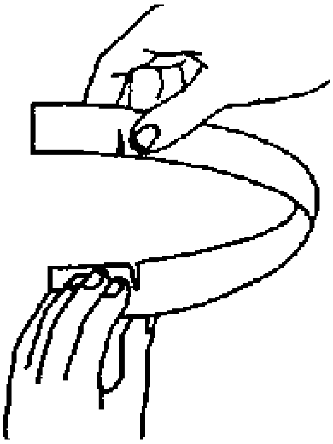


In action!

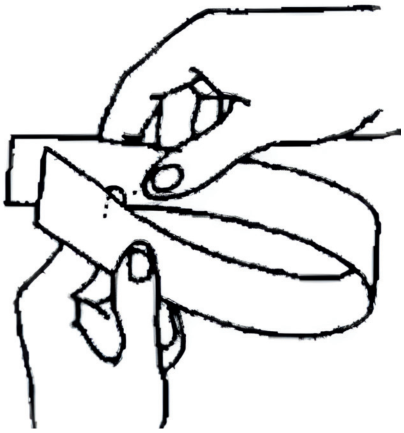
3. FLYING FISH



1. To make it all you need is a strip of old newspaper. The strip should be 2-cm wide and about 12-cm. long. Place the strip in a horizontal position. On the lower right- hand side, about 1.5-cm. from the end, cut a slit half-way across the strip.

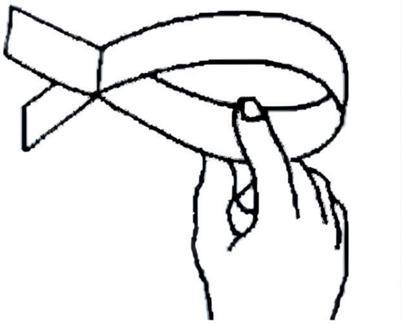


2. Make a similar cut on the upper left-hand side.

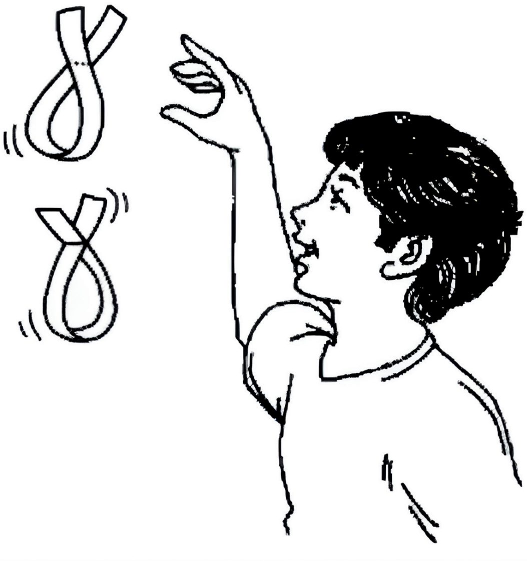


3. Slip both the slits into each other so that they interlock together.

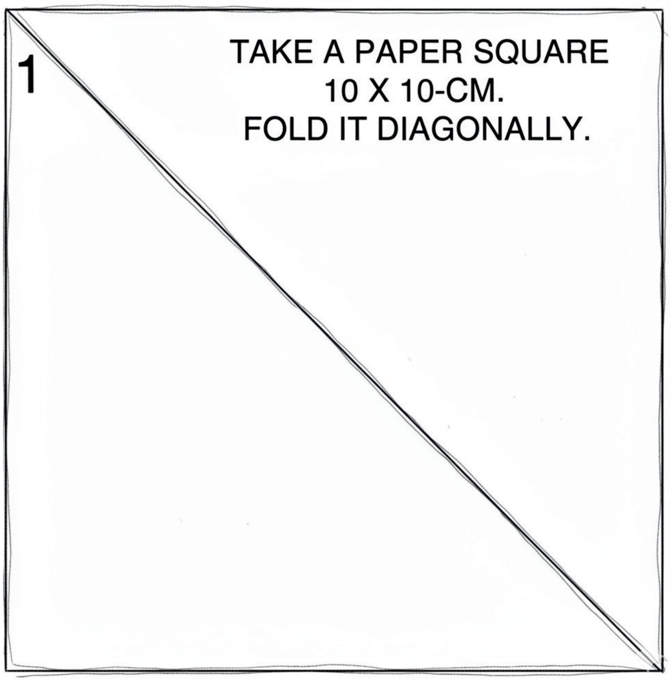
4. The fish is now complete.



5. Throw it high in the air and it will twist and turn around on its way to the ground. Try making Flying Fishes of various sizes and colours. This is the simplest and the most amazing flying object that you can make. The fish will twist and turn round and round as it comes to the ground.

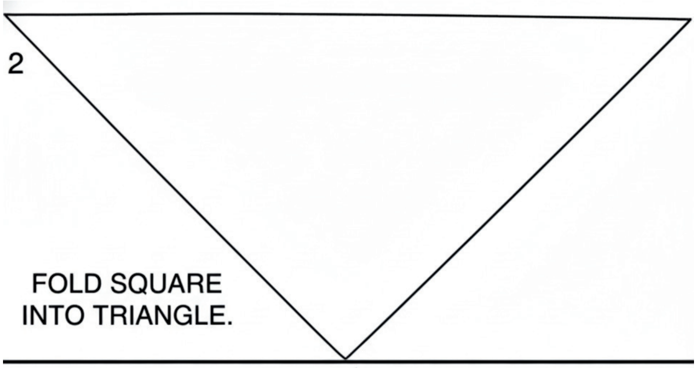


4. FLYING BAT



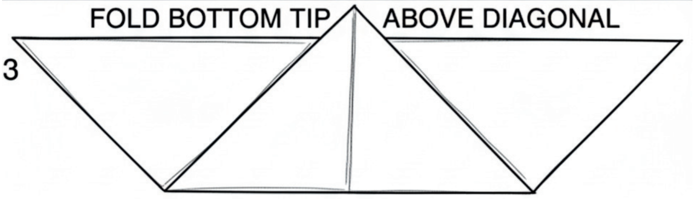
1

TAKE A PAPER SQUARE
10 X 10-CM.
FOLD IT DIAGONALLY.



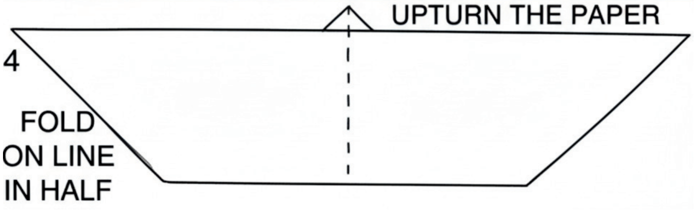
2

FOLD SQUARE
INTO TRIANGLE.



3

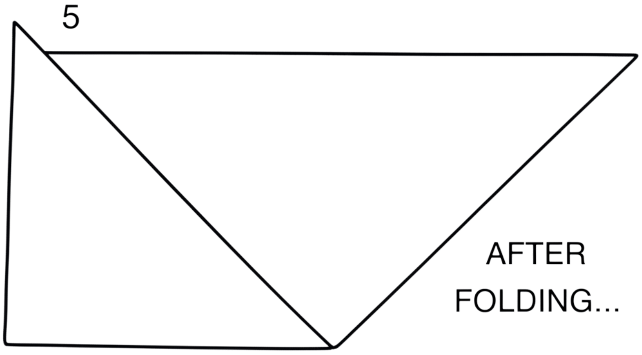
FOLD BOTTOM TIP ABOVE DIAGONAL



4

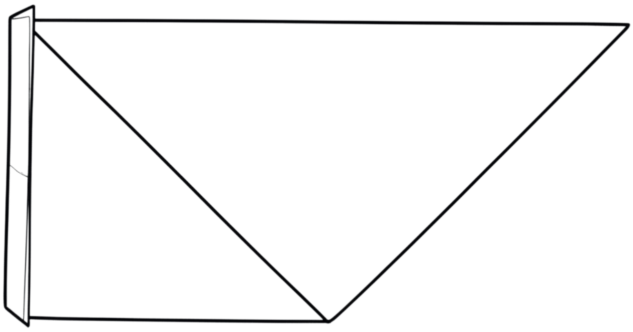
UPTURN THE PAPER

FOLD
ON LINE
IN HALF

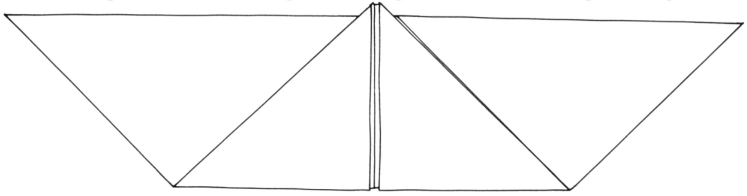


5

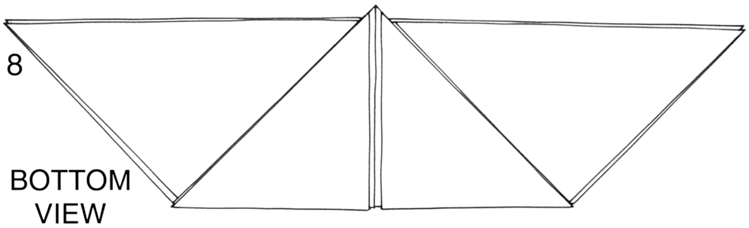
AFTER
FOLDING...



6 MAKE SMALL FOLD ON LEFT EDGE

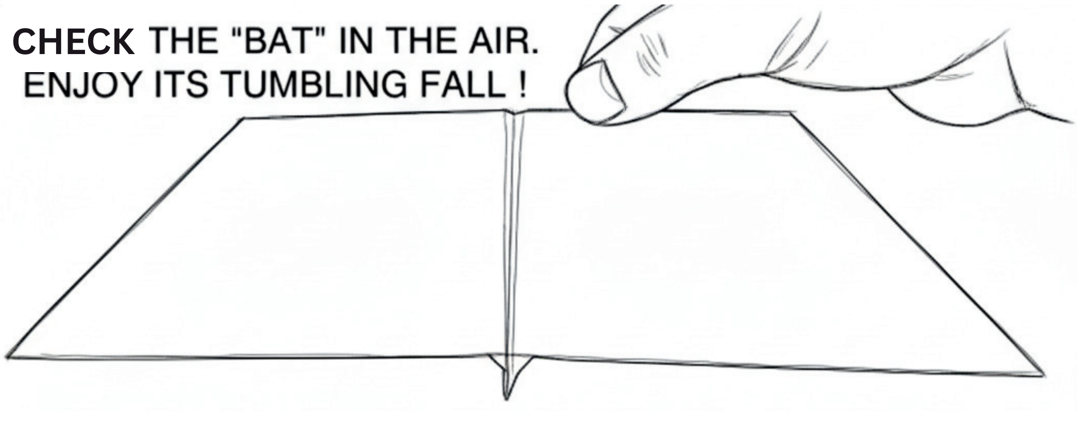


7 OPEN THE MODEL. STAND VERTICAL FOLD.



8

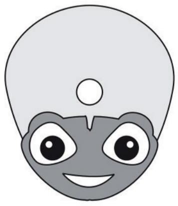
BOTTOM
VIEW

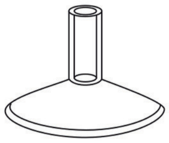


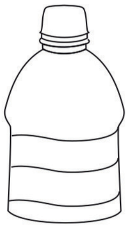
CHECK THE "BAT" IN THE AIR.
ENJOY ITS TUMBLING FALL !

5. JUMPING BUG

YOU NEED

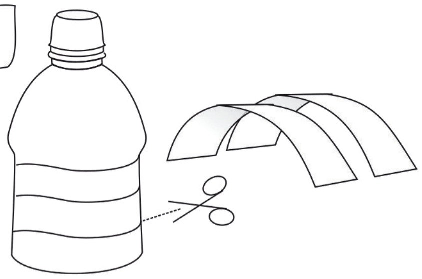

Card Bug


Suction cup


Old Bottle

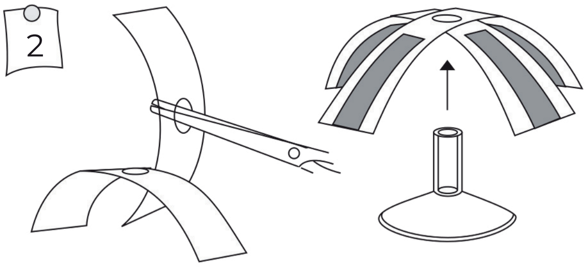
Scissors

1



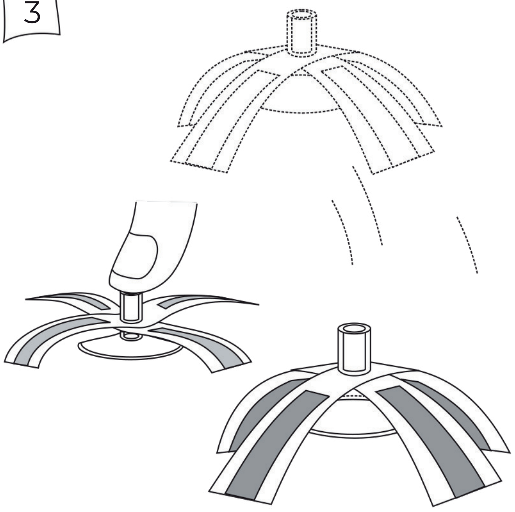
Cut a 1-cm wide ring from an old plastic bottle.

2



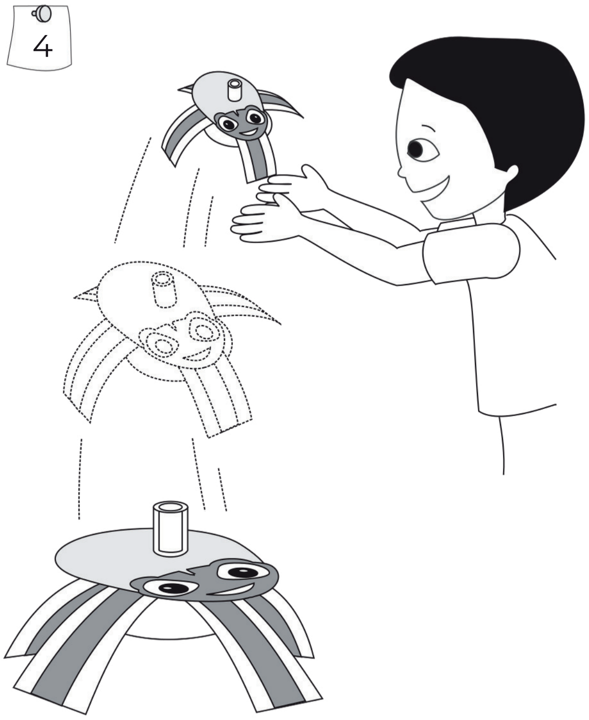
Cut in two halves and make holes in the center. Insert a small suction cup in the holes to make the Bug.

3



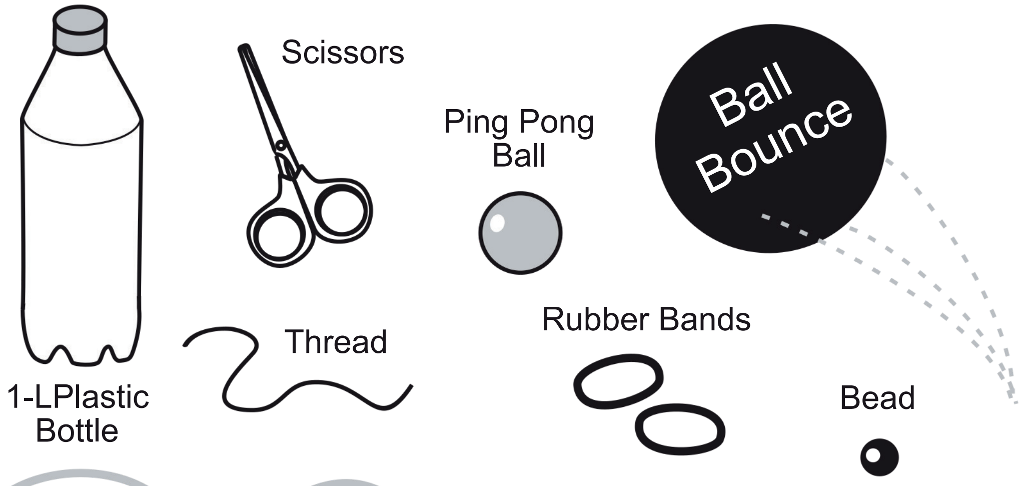
Place Bug on the table. Then press the suction cup down and leave. The Bug will flatten and then jump up. The legs act like a spring.

4



Draw a card Bug and place it on top. Now press to make it jump and then catch it.

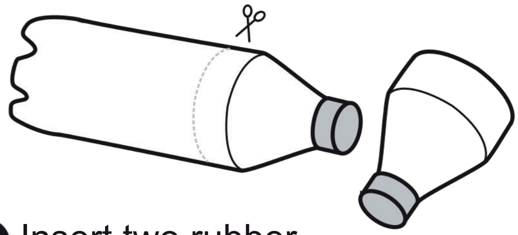
6. BALL BOUNCE



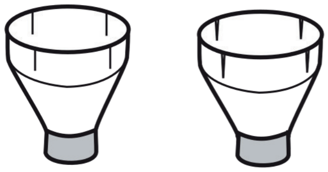
Scissors
Ping Pong Ball
Ball Bounce
1-LPlastic Bottle
Thread
Rubber Bands
Bead

1 Cut bottle 10-cm from lid. Discard the base.

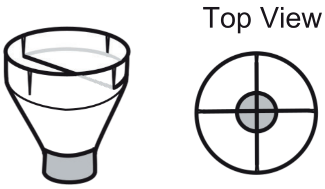
2 Mark four lines at right angles on rim.



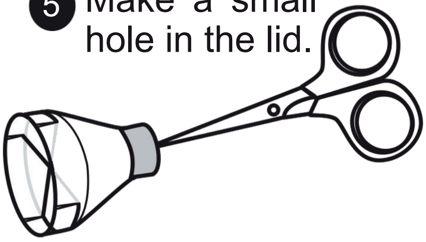
3 Make 1-cm deep cuts on all four lines.



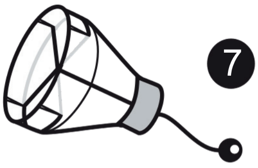
4 Insert two rubber bands in cuts. They will criss-cross in the center.



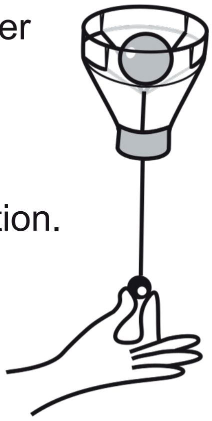
5 Make a small hole in the lid.

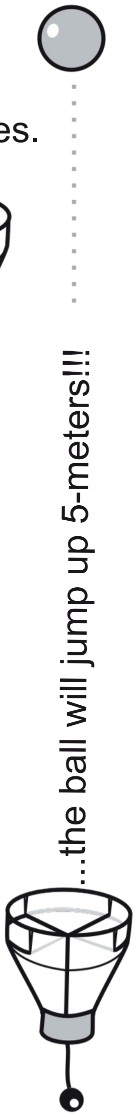


6 Tie a thread at the junction of the rubber bands and weave it through the hole. Tie a bead at the end of the thread.



7 Place the ball on the junction. On pulling the bead and releasing it...



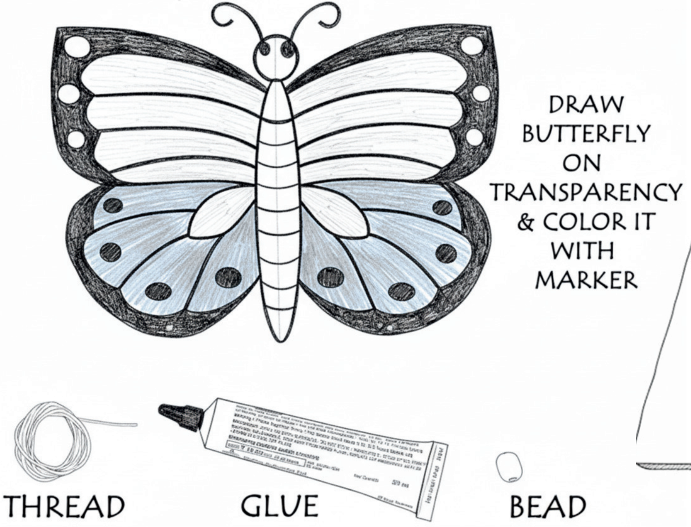


...the ball will jump up 5-meters!!!

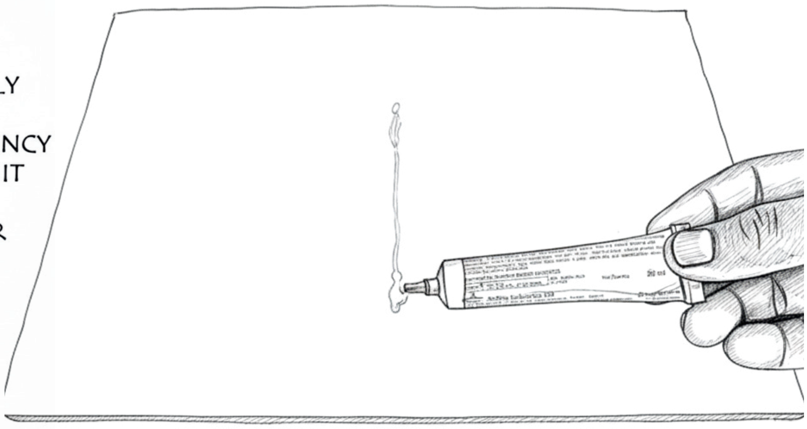
The stored energy in the stretched rubber bands propels the ball.

7. PULL AND FLAP

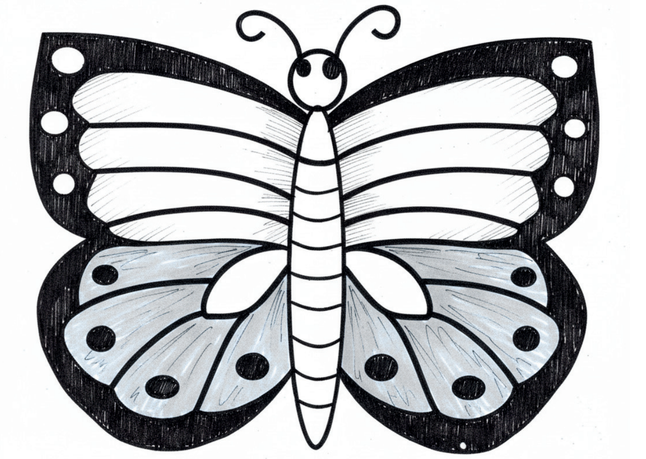
MATERIALS


DRAW BUTTERFLY ON TRANSPARENCY & COLOR IT WITH MARKER
THREAD
GLUE
BEAD

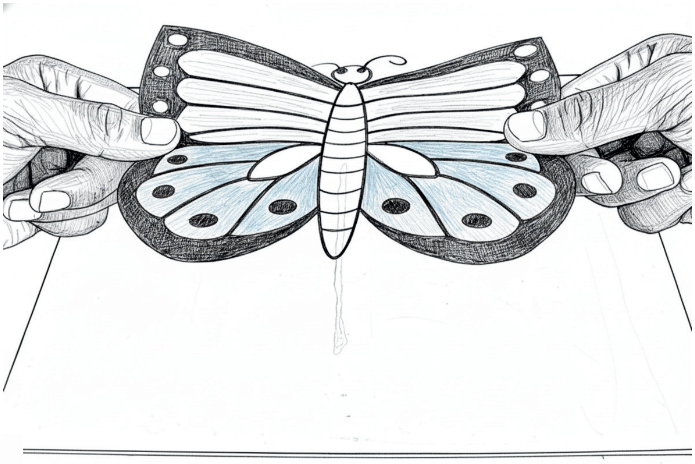
STICK A-4 SIZE SHEET ON STIFF BOARD



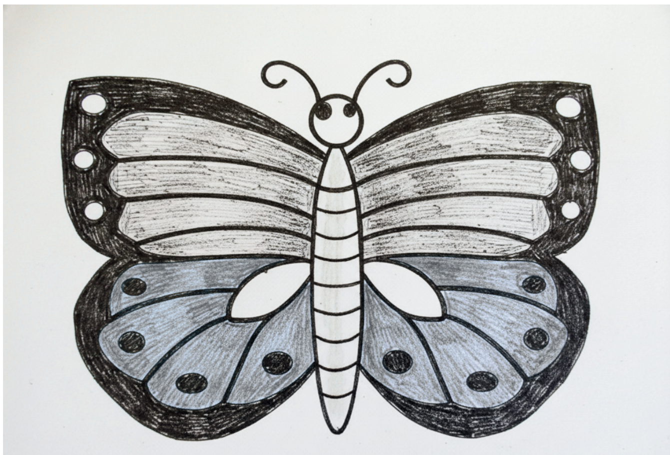
APPLY GLUE ON THE MID-LINE



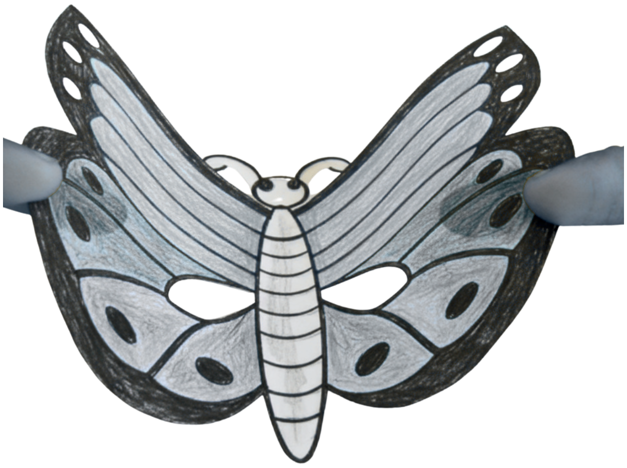
DRAW, CUT, COLOR BUTTERFLY FROM TRANSPARENCY



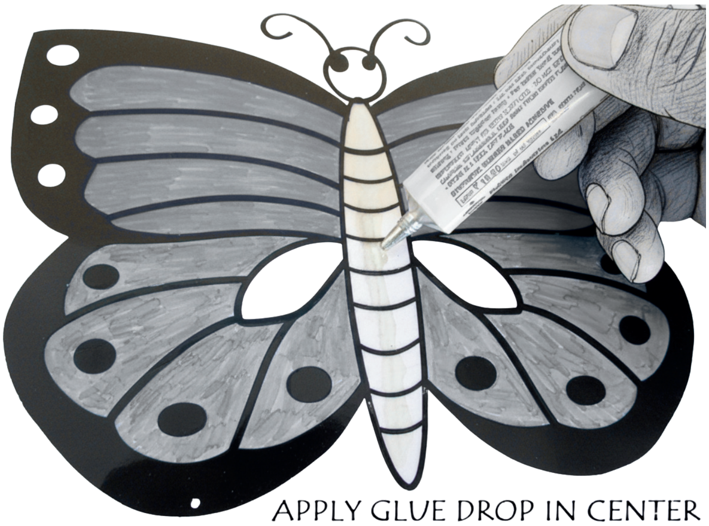
STICK MIDDLE OF BUTTERFLY ON BOARD



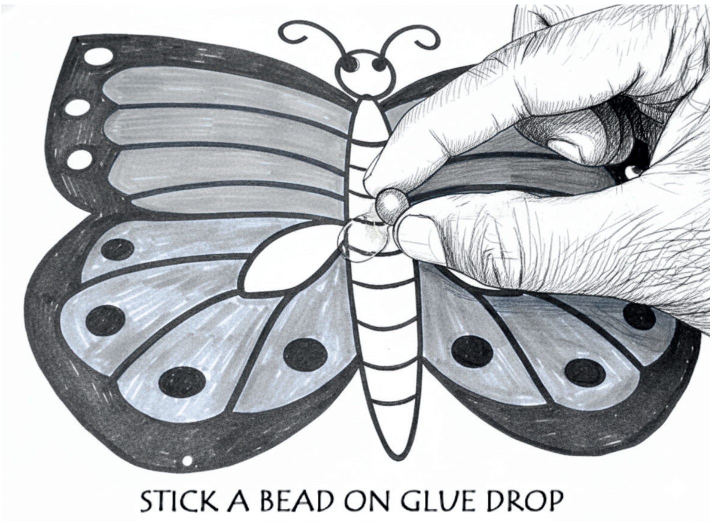
MIDDLE OF BUTTERFLY STUCK ON BOARD



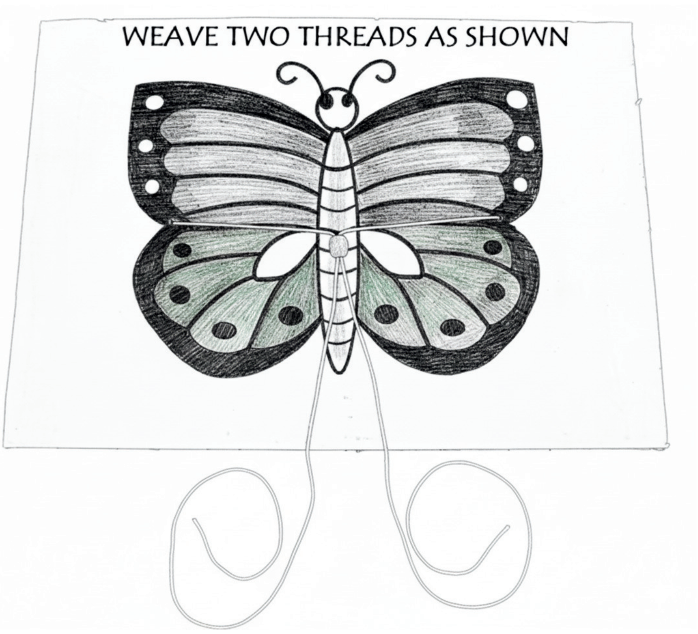
BUTTERFLY WINGS CAN LIFT AND FALL



APPLY GLUE DROP IN CENTER

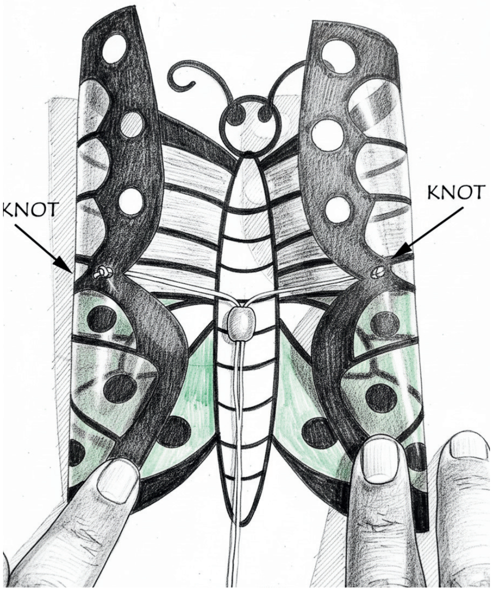


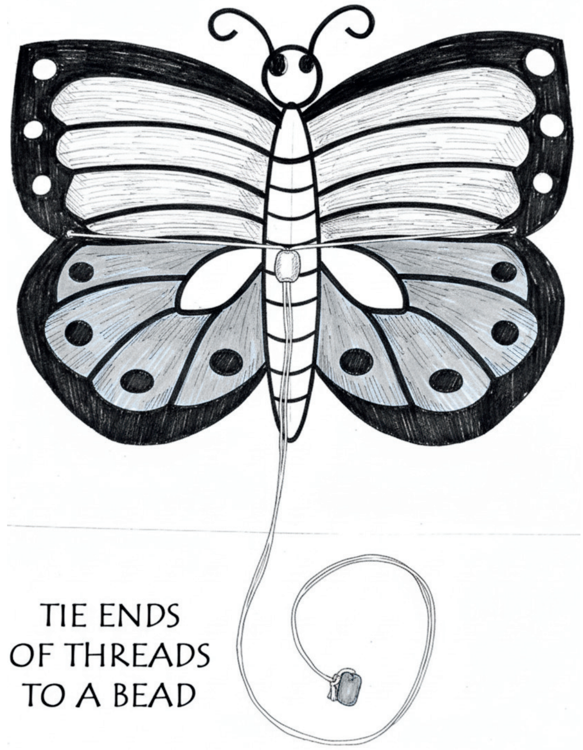
STICK A BEAD ON GLUE DROP



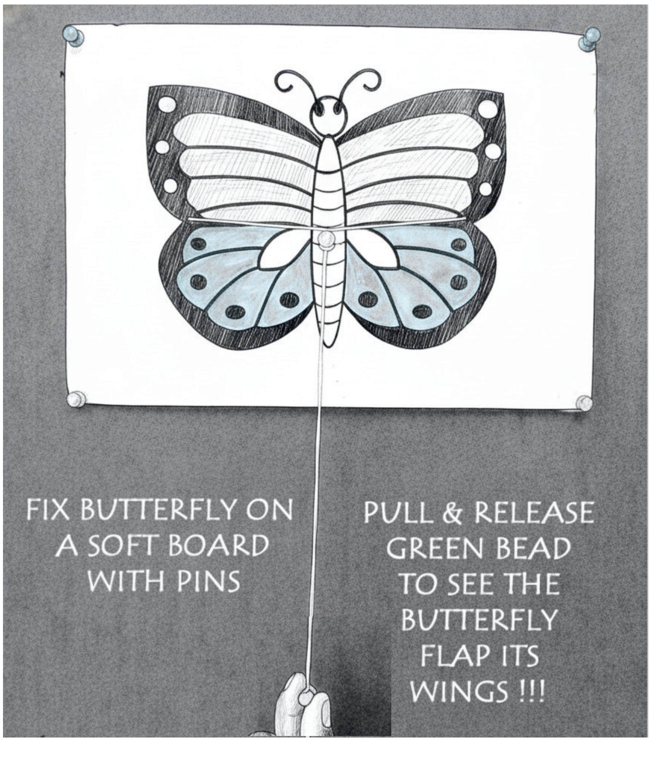
WEAVE TWO THREADS AS SHOWN

TIE KNOTS ON BACKSIDE OF BUTTERFLY





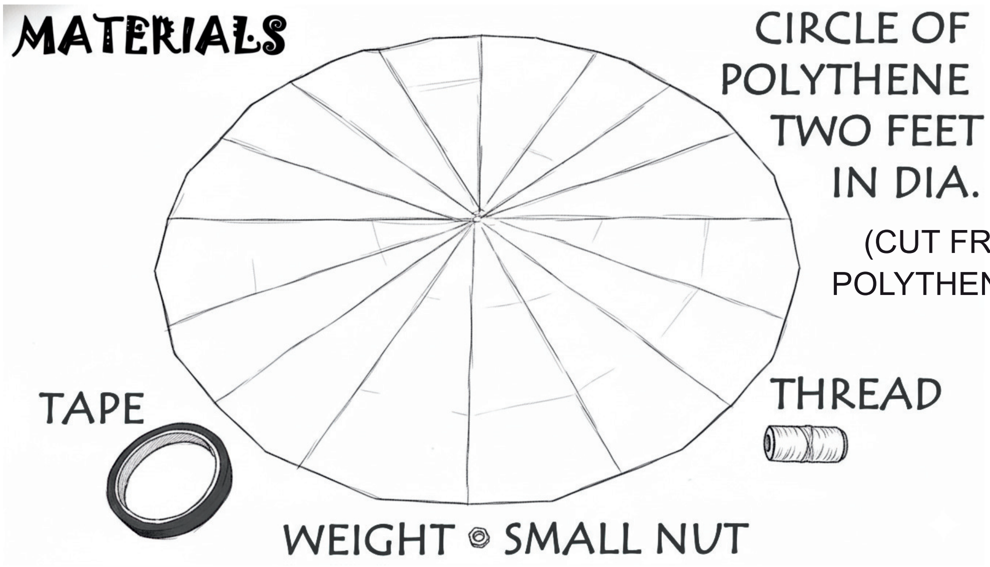
TIE ENDS
OF THREADS
TO A BEAD



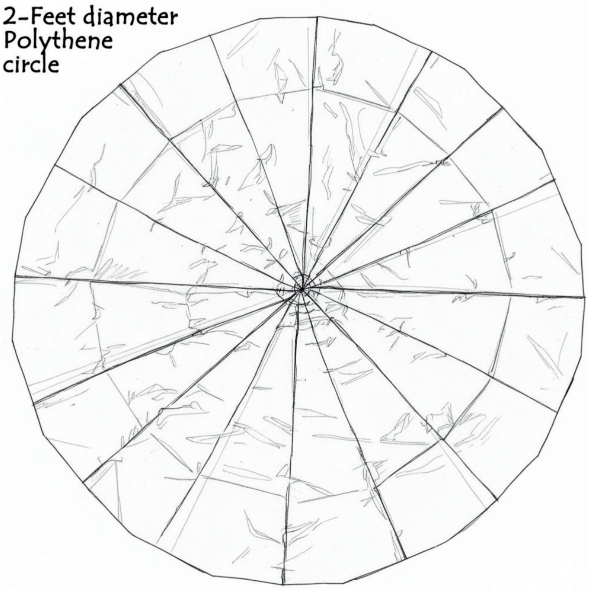
FIX BUTTERFLY ON
A SOFT BOARD
WITH PINS

PULL & RELEASE
GREEN BEAD
TO SEE THE
BUTTERFLY
FLAP ITS
WINGS !!!

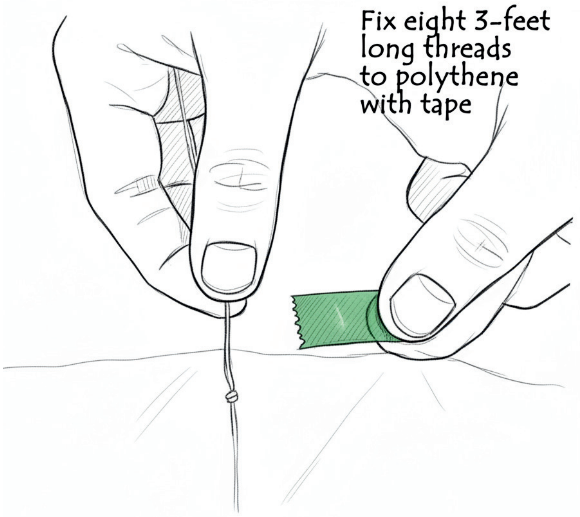
8. POLYTHENE PARACHUTE


MATERIALS
CIRCLE OF POLYTHENE TWO FEET IN DIA.
TAPE
THREAD
WEIGHT SMALL NUT

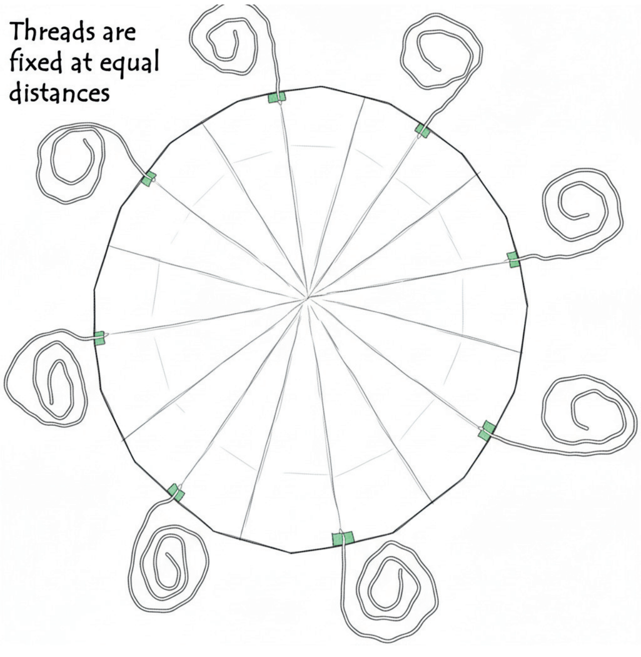
(CUT FROM A POLYTHENE BAG)



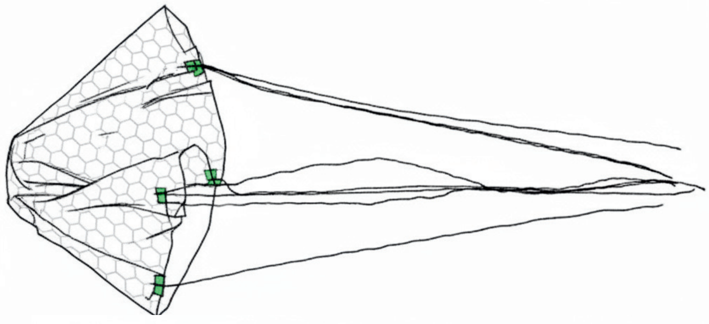
2-Feet diameter Polythene circle



Fix eight 3-feet long threads to polythene with tape

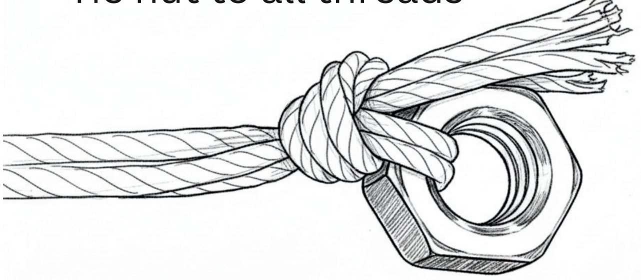


Threads are fixed at equal distances



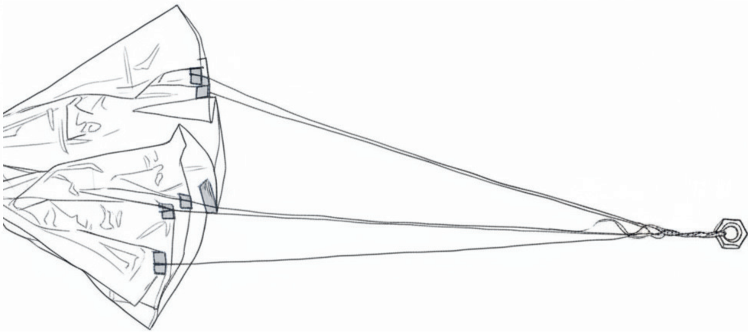
Gather threads
Polythene will look like an umbrella

Tie nut to all threads

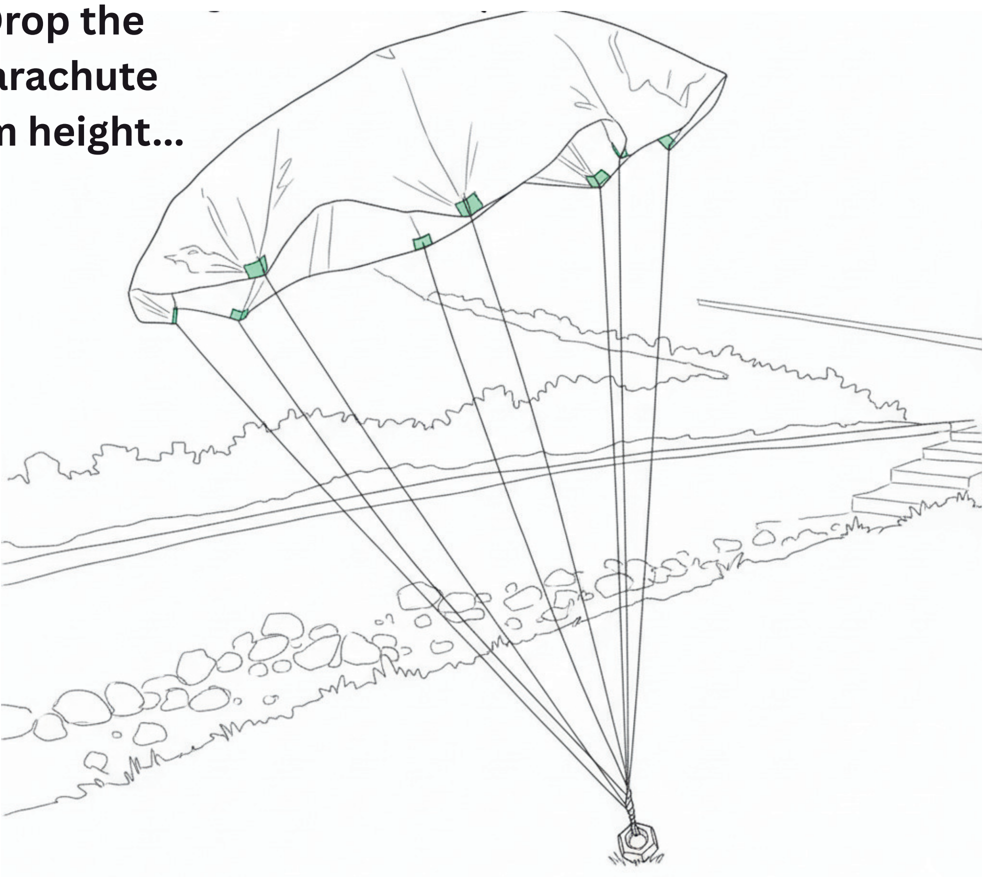


Thread and nut tied together

Parachute ready for launch...

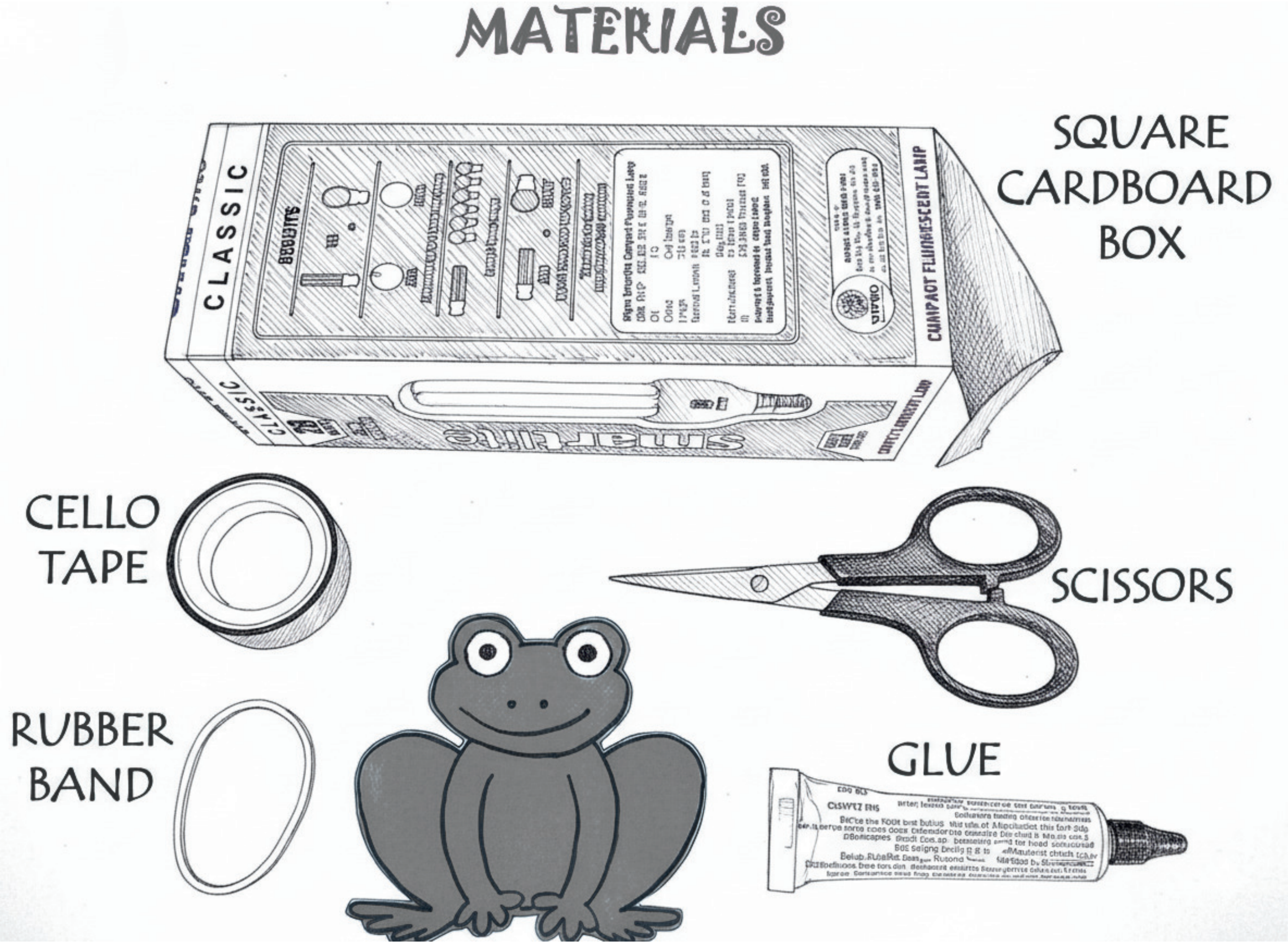


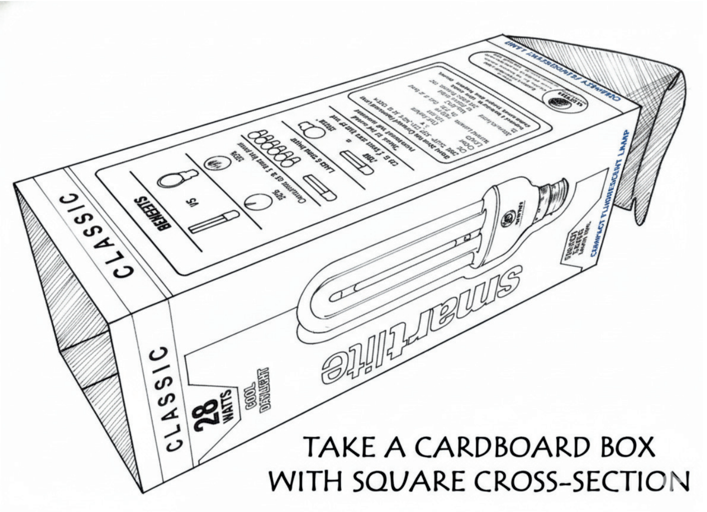
Drop the parachute from height...



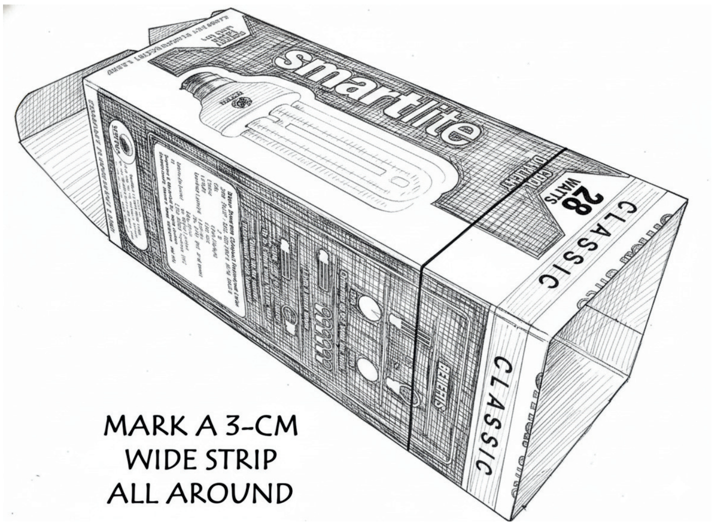
Parachute glides beautifully..

9. STRETCH AND JUMP

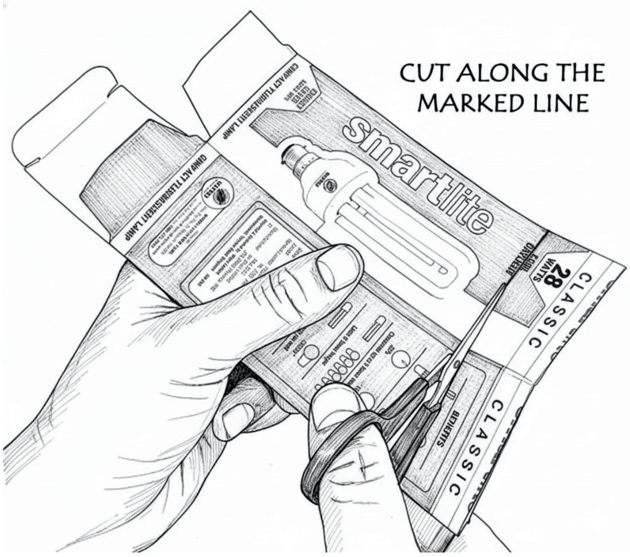

MATERIALS
SQUARE CARDBOARD BOX
CELLO TAPE
SCISSORS
RUBBER BAND
GLUE



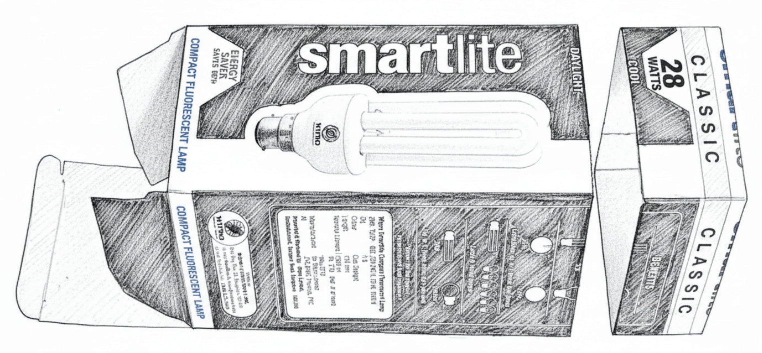
TAKE A CARDBOARD BOX WITH SQUARE CROSS-SECTION



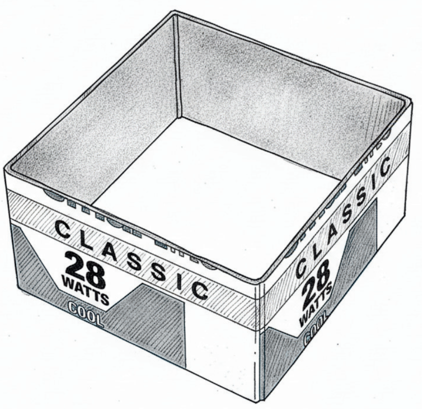
MARK A 3-CM WIDE STRIP ALL AROUND


smartlite
COMPACT FLUORESCENT LAMP
28 WATTS
CLASSIC

CUT ALONG THE MARKED LINE

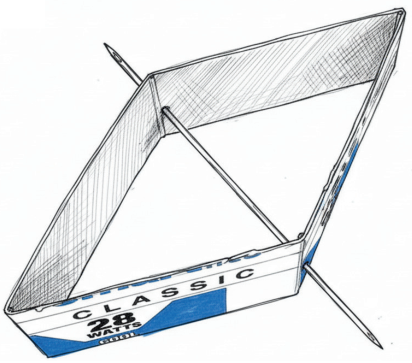

smartlite
DAYLIGHT
ENERGY SAVER
COMPACT FLUORESCENT LAMP
28 WATTS
COOL
CLASSIC

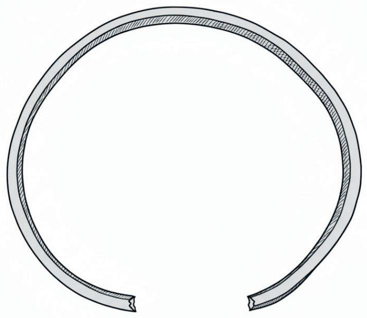
WE WILL NEED ONLY THE RIGHT HAND PART


CLASSIC
28 WATTS
COOL

FORM A SQUAR

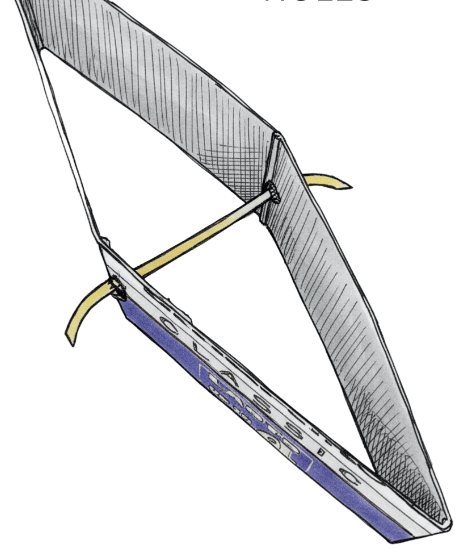
MAKE DIAGONAL HOLE WITH A FAT NEEDLE

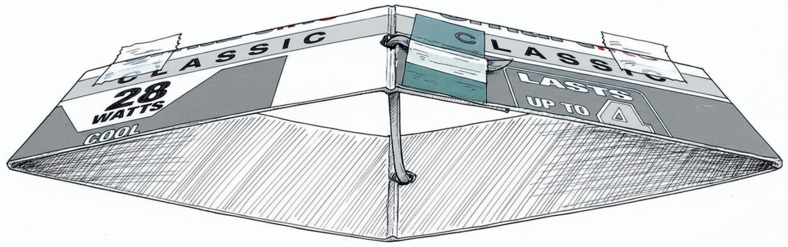

CLASSIC
28 WATTS



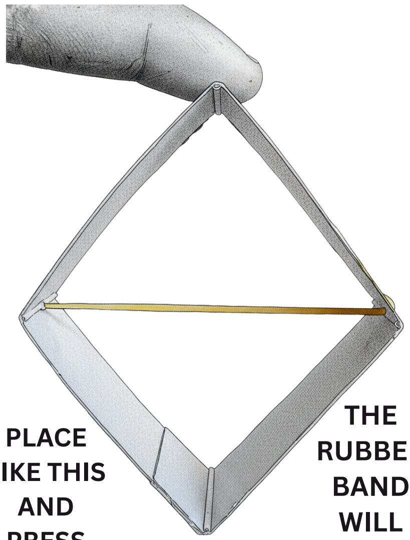
CUT A RUBBER BAND

WEAVE THE CUT RUBBER BAND THROUGH THE HOLES



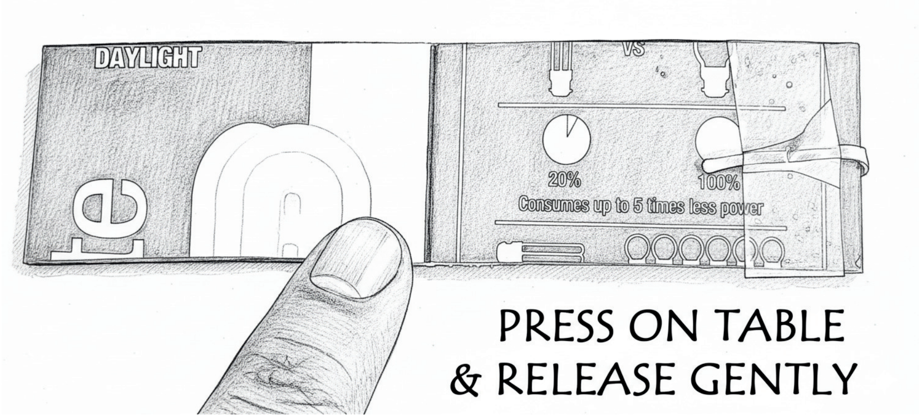

CLASSIC
28 WATTS
COOL
LASTS UP TO 4

SECURE BOTH ENDS WITH TAPE

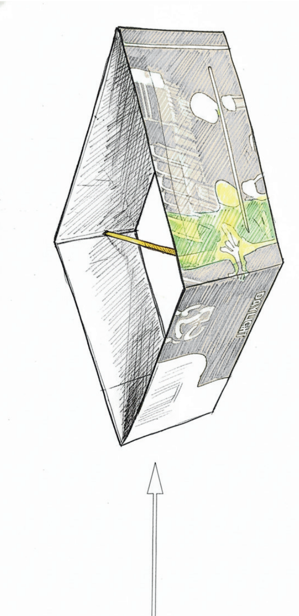


PLACE LIKE THIS AND PRESS DOWN

THE RUBBER BAND WILL STRETCH

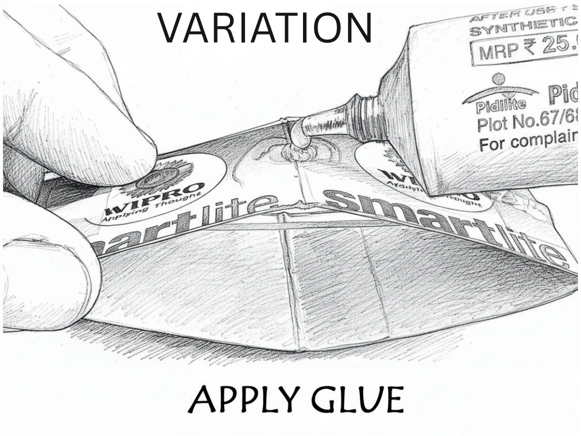

DAYLIGHT
VS
20%
100%
Consumes up to 5 times less power

PRESS ON TABLE
& RELEASE GENTLY

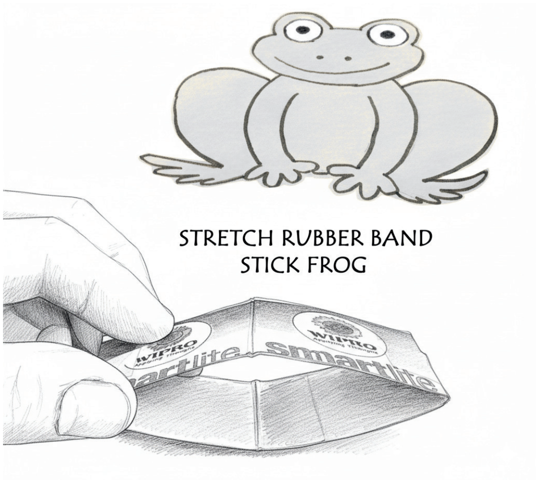


THE CARDBOARD TOY WILL JUMP UP

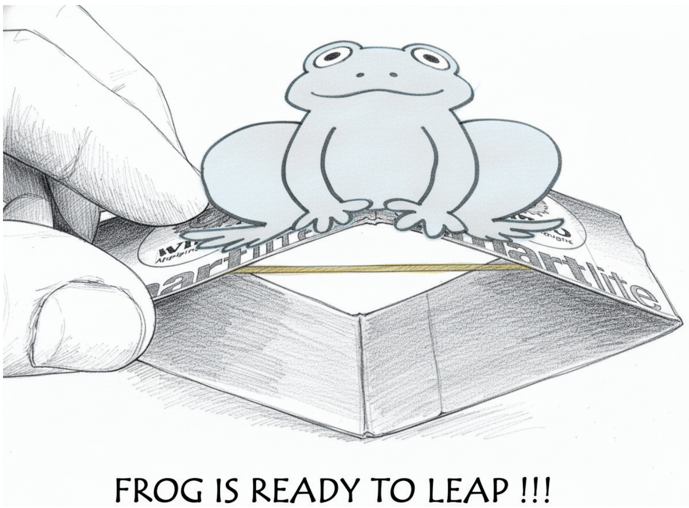
VARIATION


SYNTHETIC
Pidilite
WIPRO
smartlite

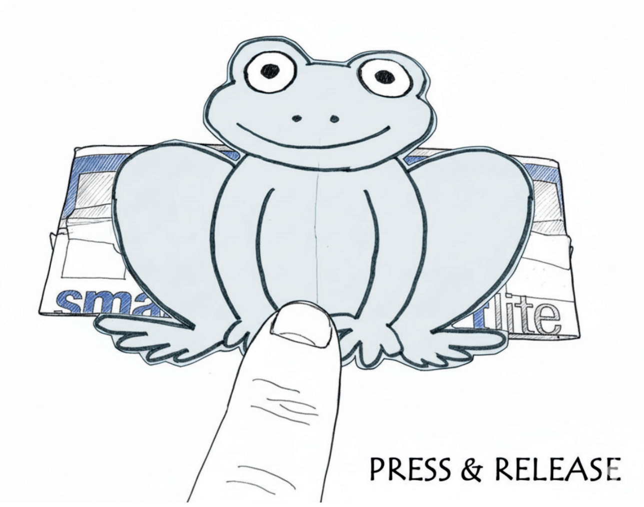
APPLY GLUE


WIPRO
smartlite

STRETCH RUBBER BAND
STICK FROG


WIPRO
smartlite

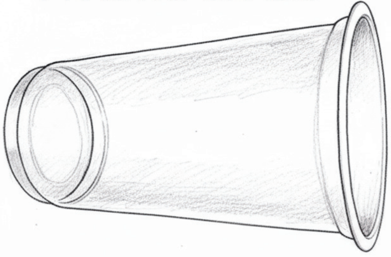
FROG IS READY TO LEAP !!!

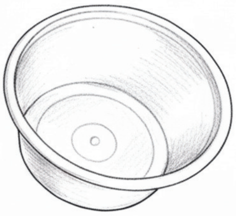


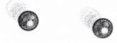
PRESS & RELEASE

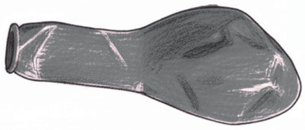
10. BALL TRAMPOLINE

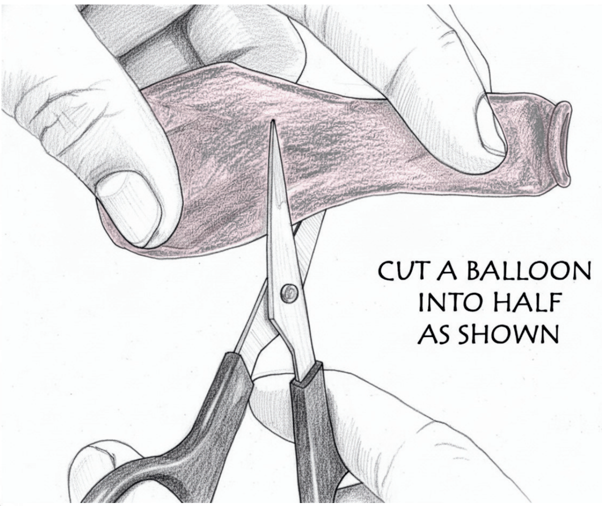
MATERIALS

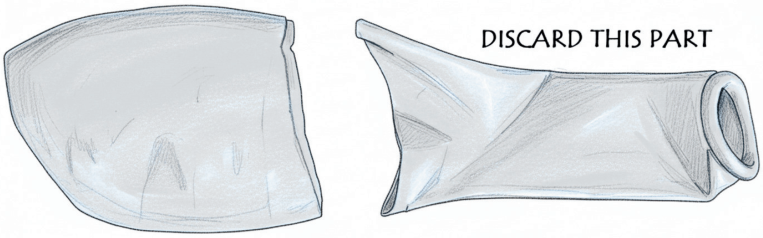

PLASTIC GLASS


PLASTIC CUP

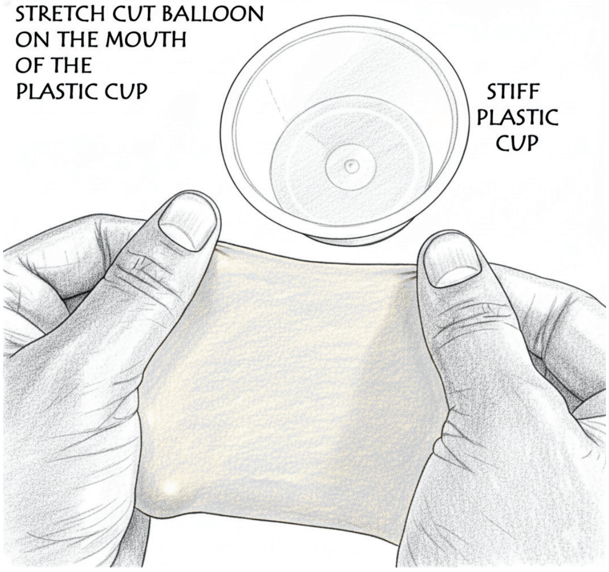

CYCLE
BALL BEARING


BALLOON


CUT A BALLOON
INTO HALF
AS SHOWN

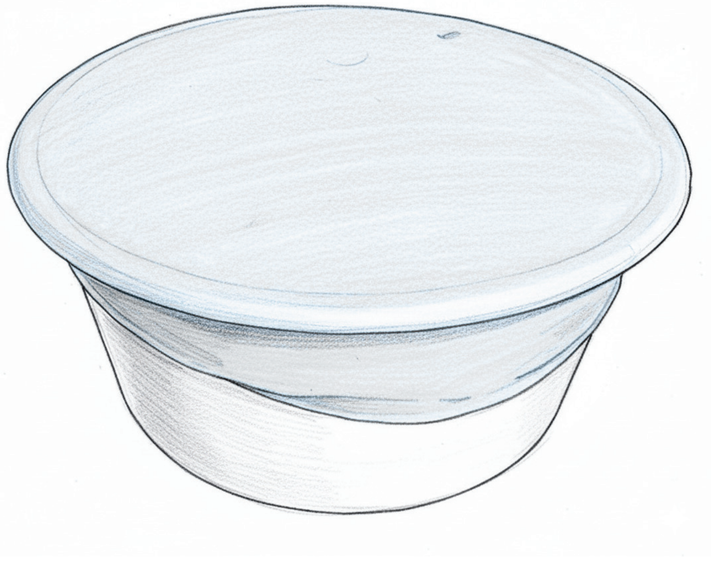

DISCARD THIS PART

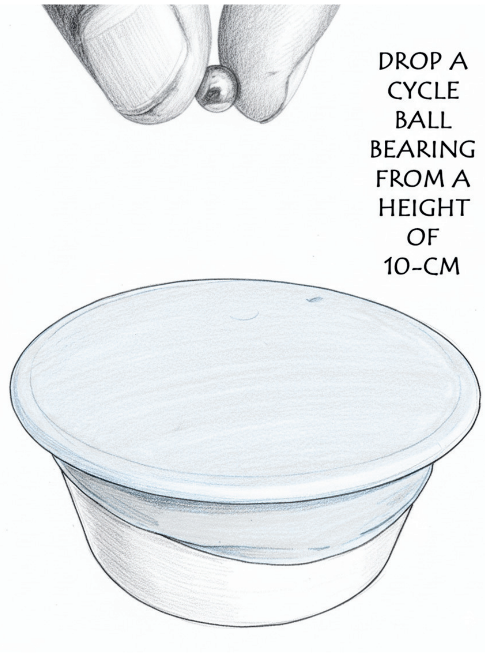
USE ONLY THE
LOWER HALF

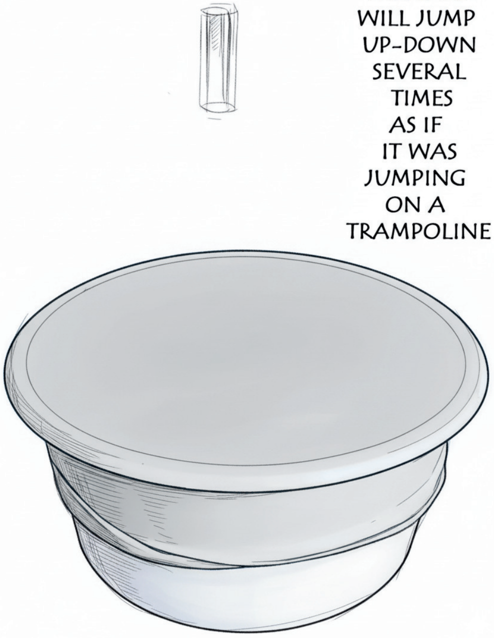

STRETCH CUT BALLOON
ON THE MOUTH
OF THE
PLASTIC CUP

STIFF
PLASTIC
CUP

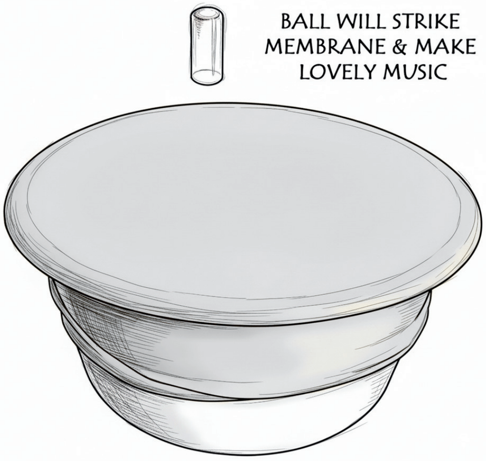
STRETCHED BALLOON ON THE
MOUTH OF A STIFF PLASTIC CUP




DROP A
CYCLE
BALL
BEARING
FROM A
HEIGHT
OF
10-CM

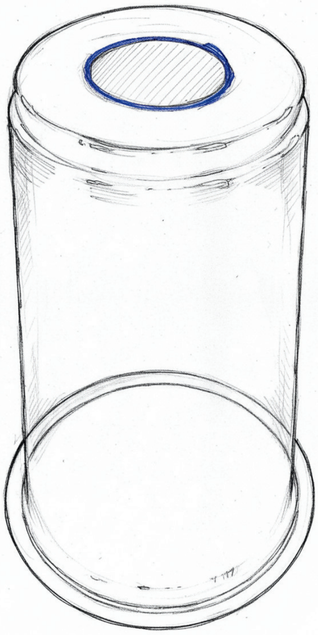


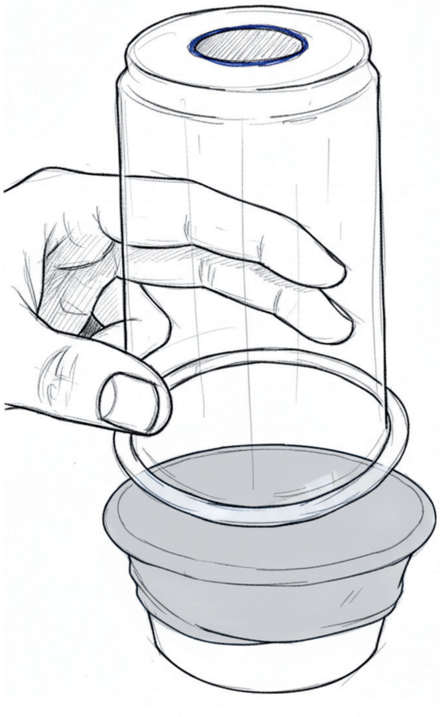
THE BALL
WILL JUMP
UP-DOWN
SEVERAL
TIMES
AS IF
IT WAS
JUMPING
ON A
TRAMPOLINE



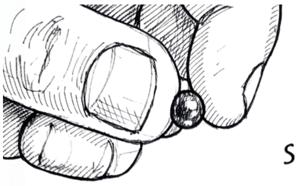
BALL WILL STRIKE
MEMBRANE & MAKE
LOVELY MUSIC

MAKE A HOLE IN THE BASE
OF A TALL PLASTIC GLASS

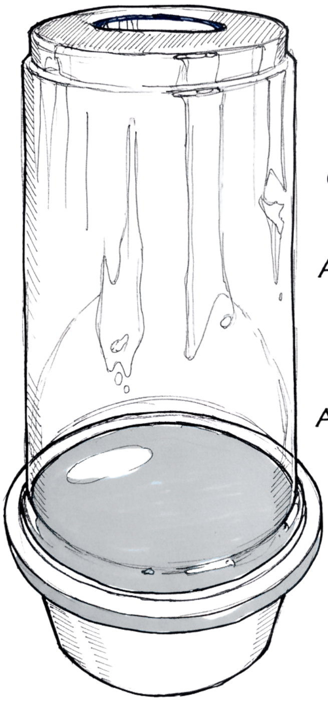




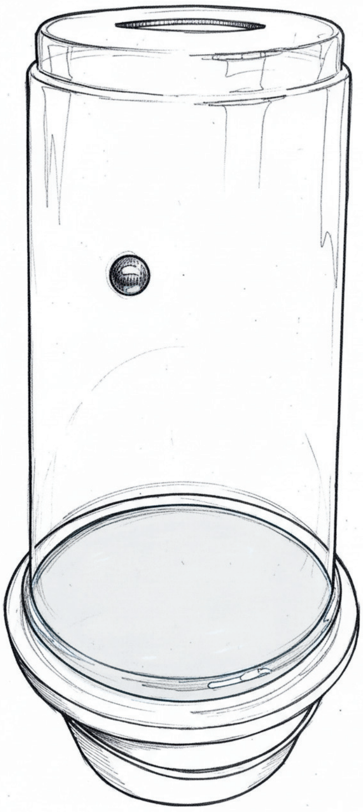
PLACE GLASS ON MEMBRANE



DROP
STEEL BALL



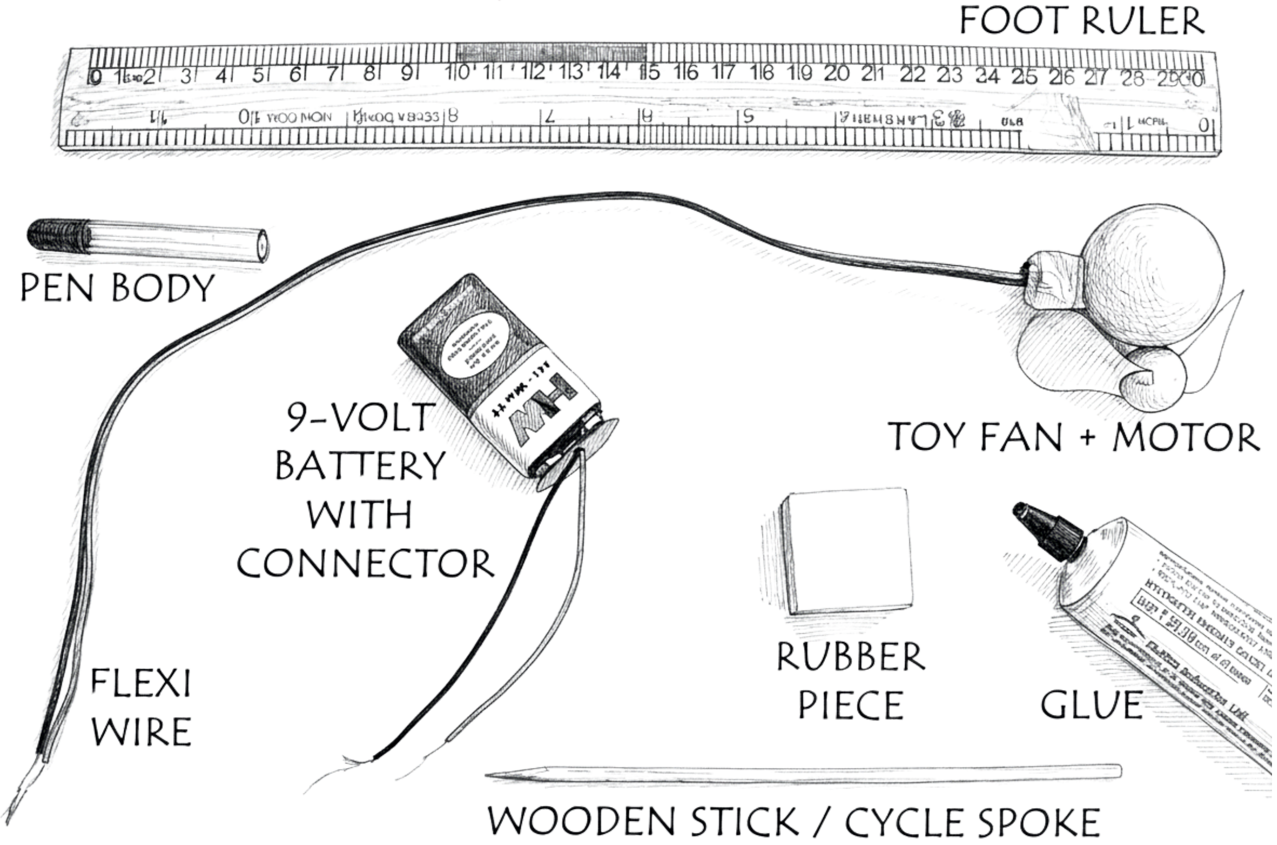
THE
GLASS
WILL
NOT
ALLOW
THE
BALL
TO
GO
ASTRAY

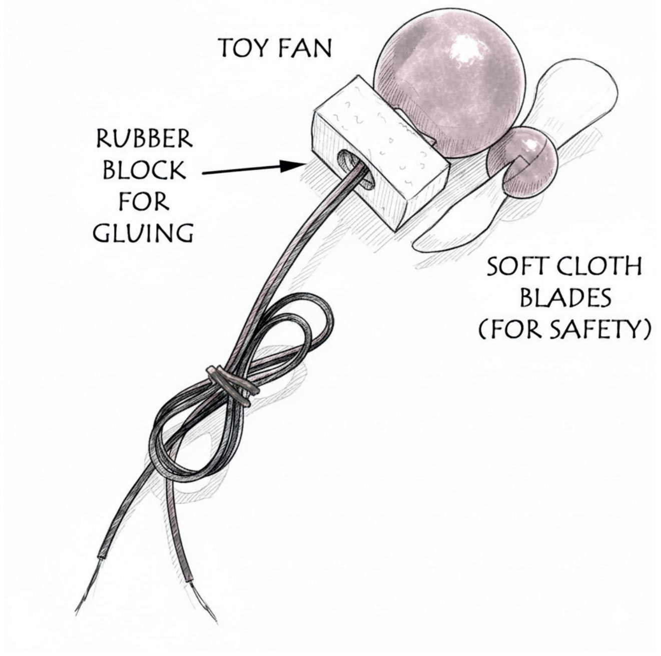


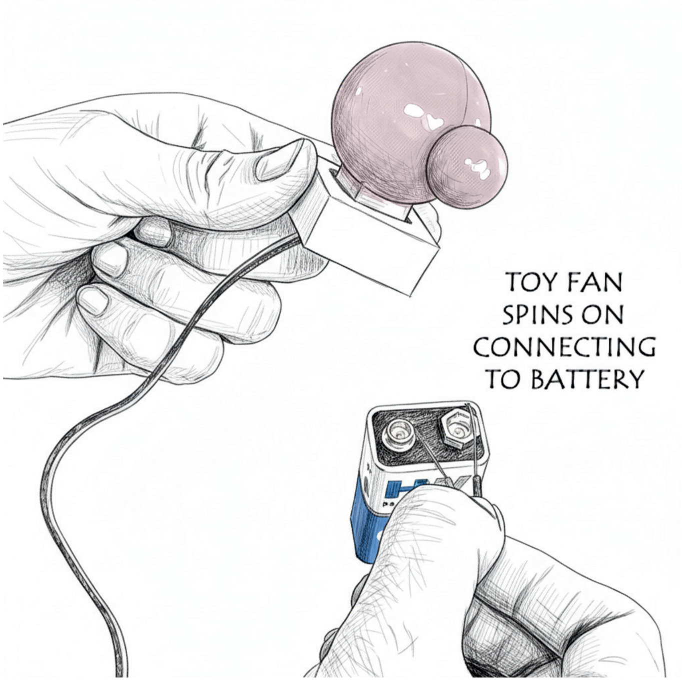
BALL WILL STRIKE MEMBRANE
AND MAKE LOVELY MUSIC

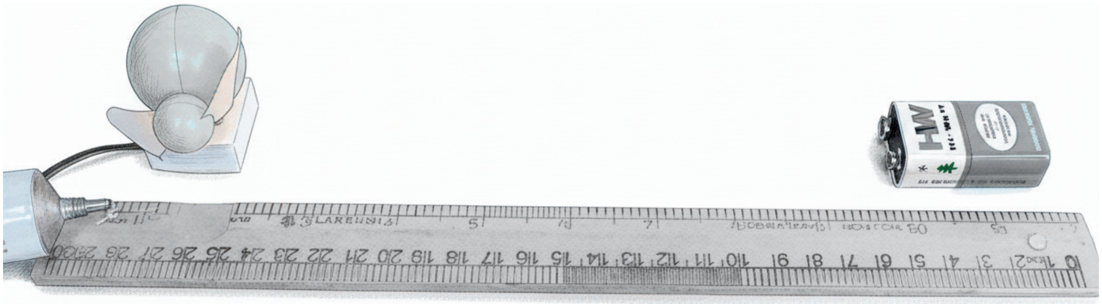
11. HELICOPTER FAN

MATERIALS

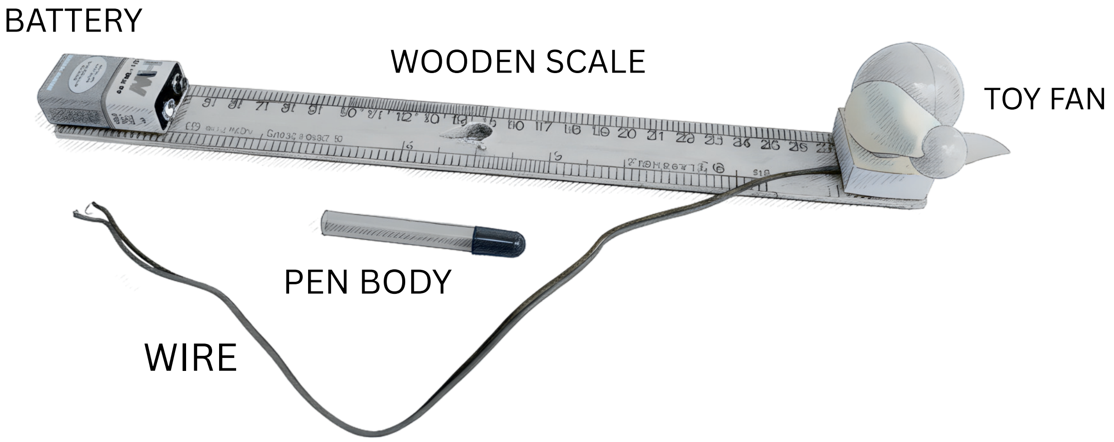

FOOT RULER
PEN BODY
9-VOLT BATTERY WITH CONNECTOR
TOY FAN + MOTOR
FLEXI WIRE
RUBBER PIECE
GLUE
WOODEN STICK / CYCLE SPOKE

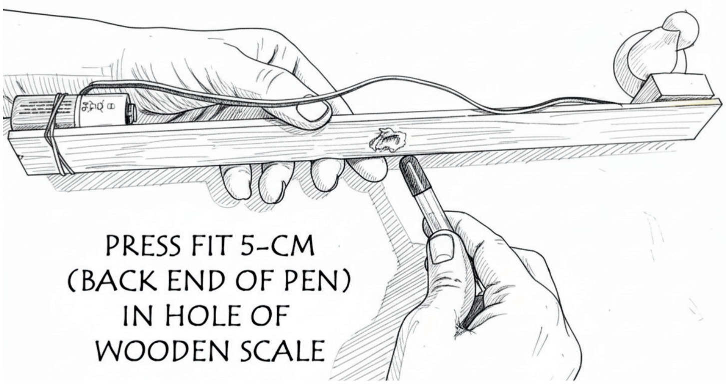

TOY FAN
RUBBER BLOCK FOR GLUING
SOFT CLOTH BLADES (FOR SAFETY)


TOY FAN SPINS ON CONNECTING TO BATTERY

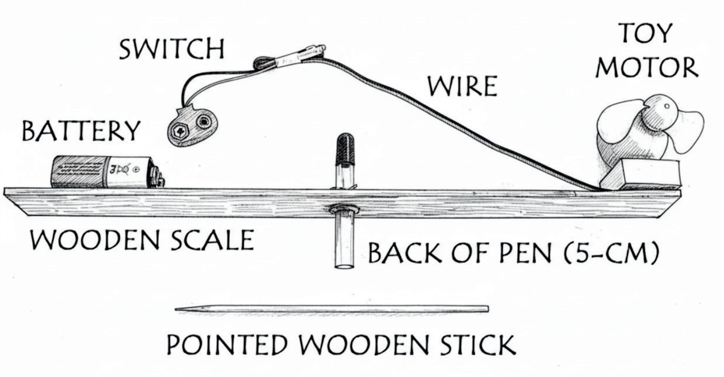


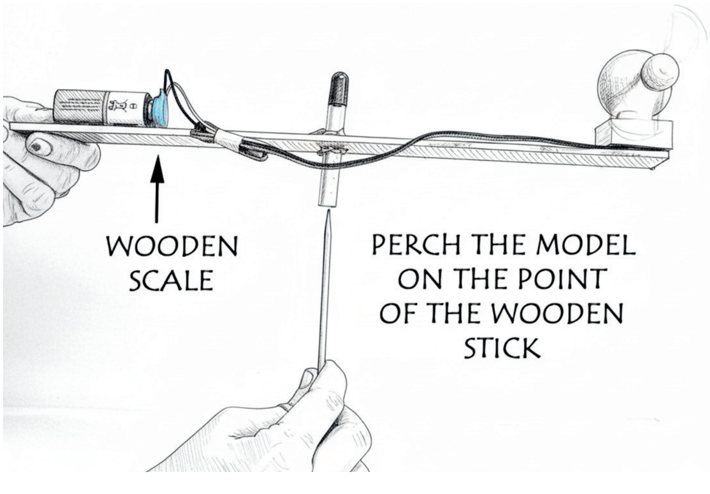
APPLY RUBBER GLUE ON BOTH ENDS OF 30-CM WOODEN SCALE


BATTERY
WOODEN SCALE
TOY FAN
PEN BODY
WIRE



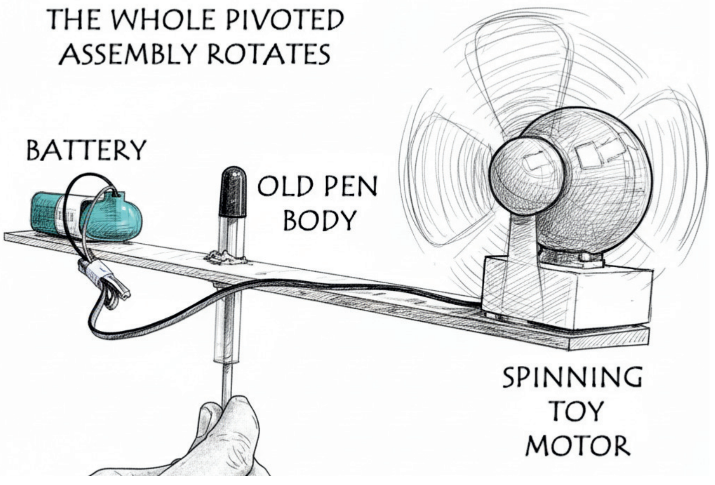
PRESS FIT 5-CM (BACK END OF PEN) IN HOLE OF WOODEN SCALE


SWITCH
TOY MOTOR
WIRE
BATTERY
WOODEN SCALE
BACK OF PEN (5-CM)
POINTED WOODEN STICK

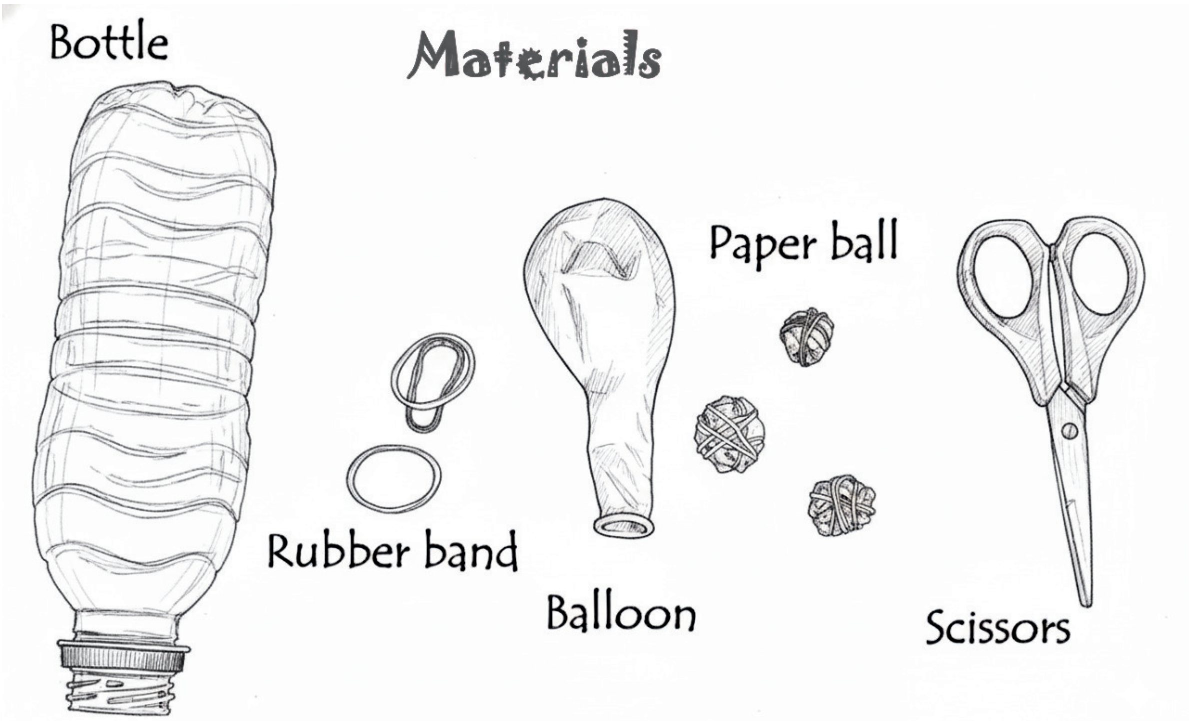

WOODEN SCALE

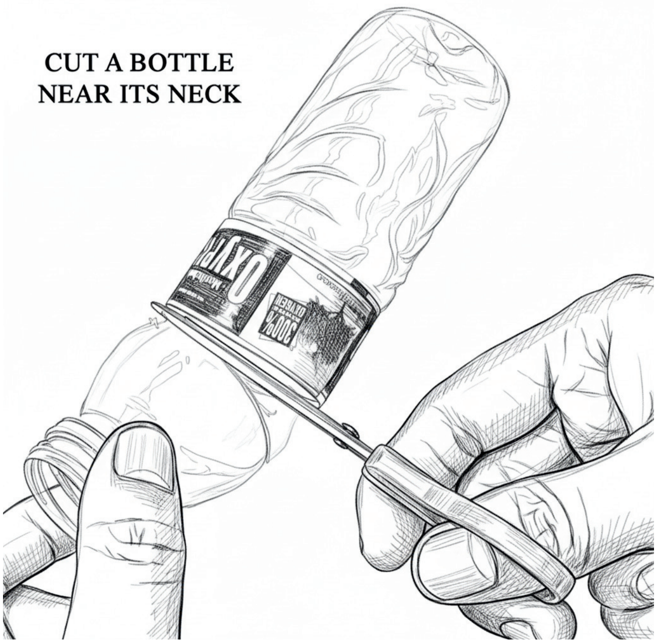
PERCH THE MODEL ON THE POINT OF THE WOODEN STICK

AS THE MOTOR SPINS THE WHOLE PIVOTED ASSEMBLY ROTATES

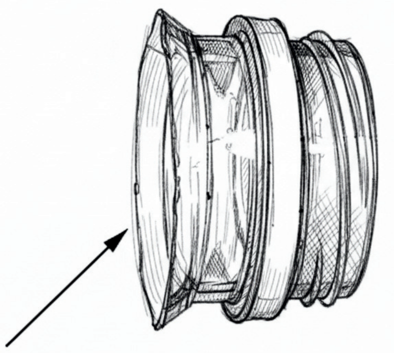

BATTERY
OLD PEN BODY
SPINNING TOY MOTOR

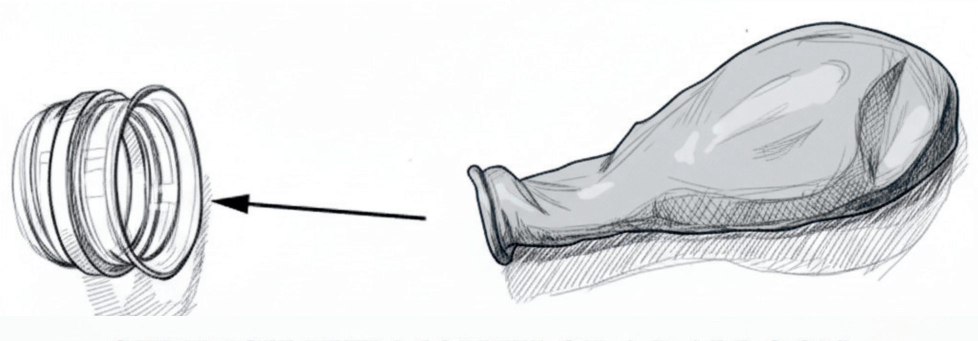
12. BALL SHOOTER


Materials
Bottle
Rubber band
Balloon
Paper ball
Scissors

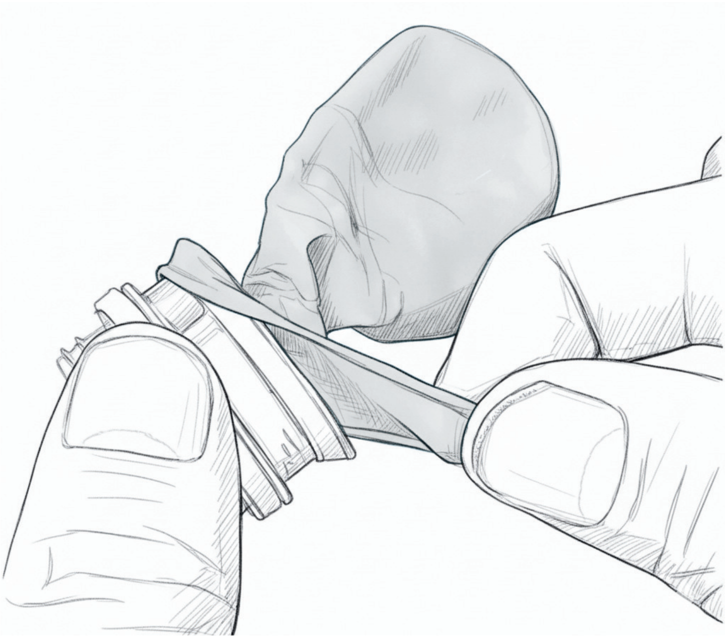

CUT A BOTTLE
NEAR ITS NECK

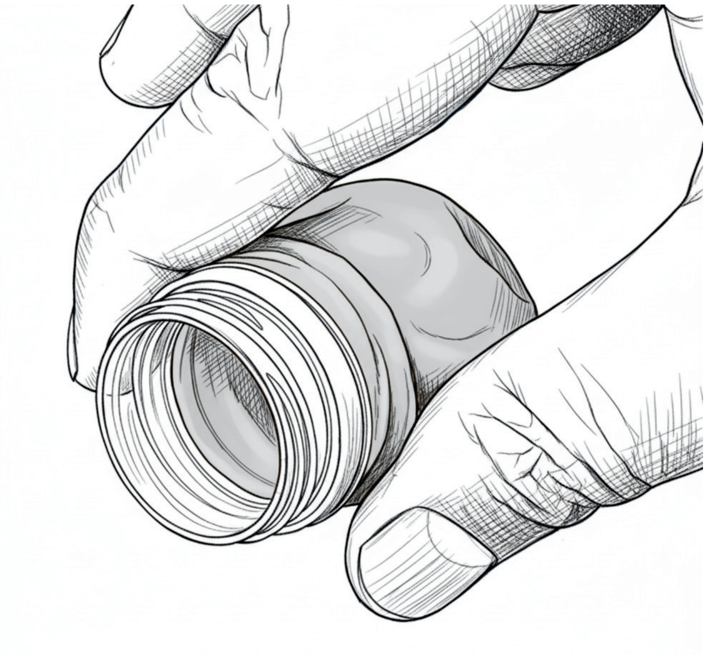
TRIM THE CUT PORTION
VERY CLOSE TO THE NECK AS SHOWN


TRIM
(NO
SHARP
EDGES)

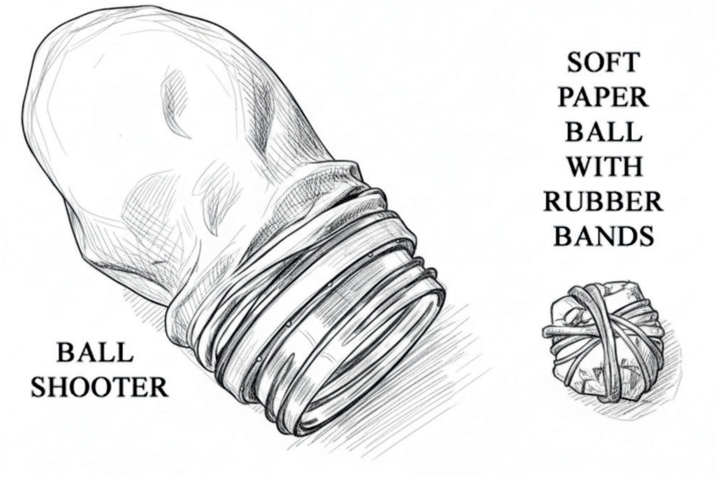

STRETCH THE MOUTH OF A BALLOON
AND INSERT IT IN THE BOTTLE NECK

STRETCH THE BALLOON AND PLACE IT ON BOTTLE NECK



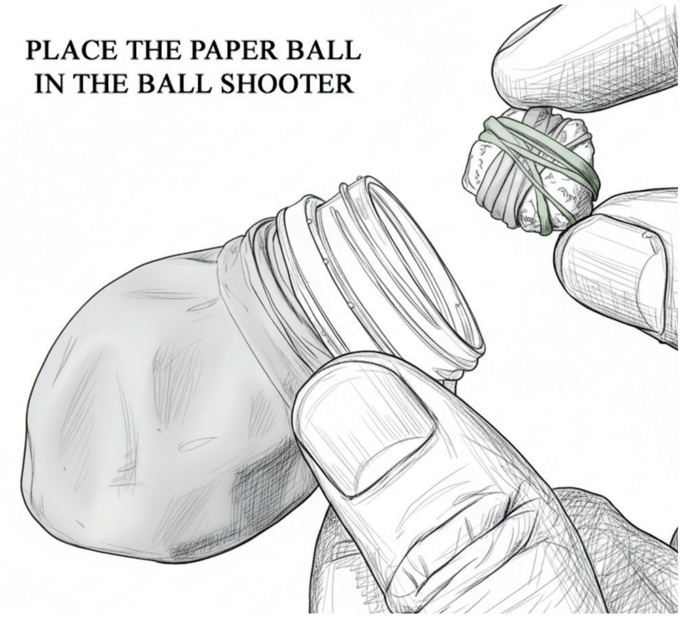


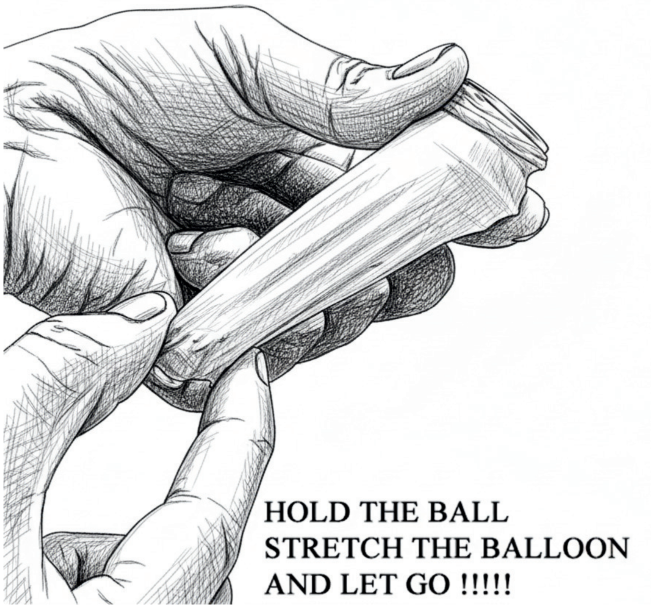
HERE THE STRETCHED BALLOON
IS FIRMLY PLACED ON THE BOTTLE NECK


SOFT PAPER BALL WITH RUBBER BANDS
BALL SHOOTER

NOW PLACE THE PAPER BALL IN THE SHOOTER

PLACE THE PAPER BALL
IN THE BALL SHOOTER

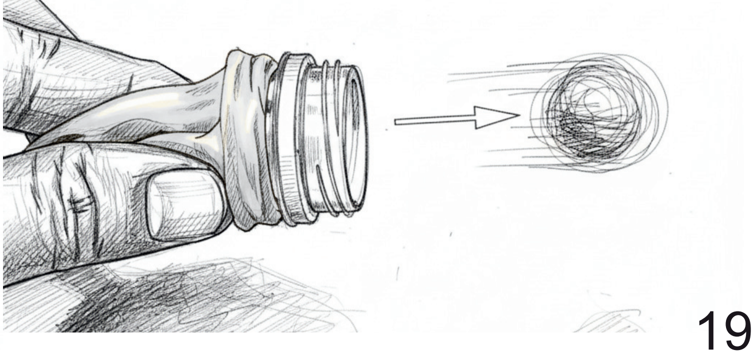




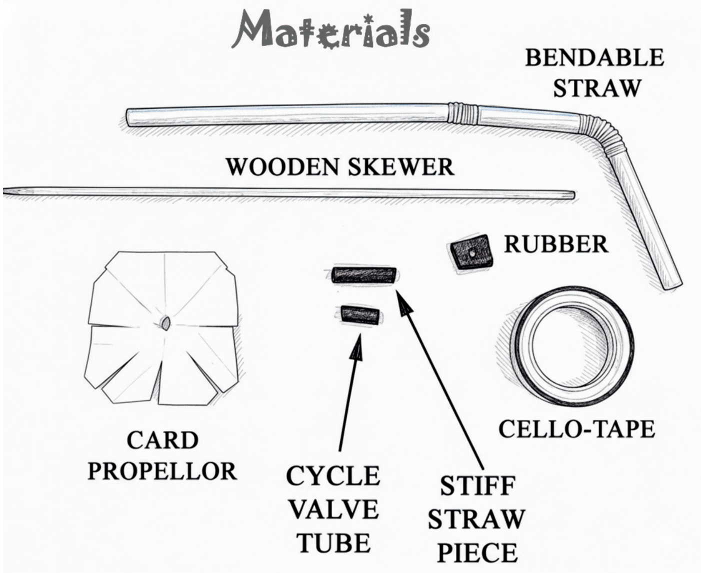
HOLD THE BALL
STRETCH THE BALLOON
AND LET GO !!!!!

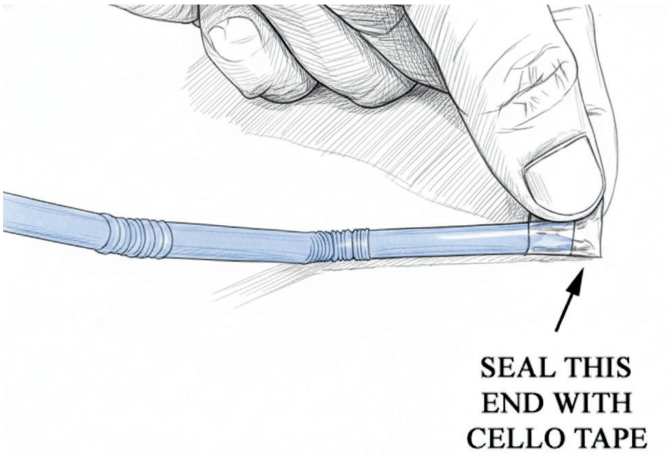
THE BALL WILL
FLY FAR AND LAND
20-METERS AWAY !!

20-METERS AWAY !!

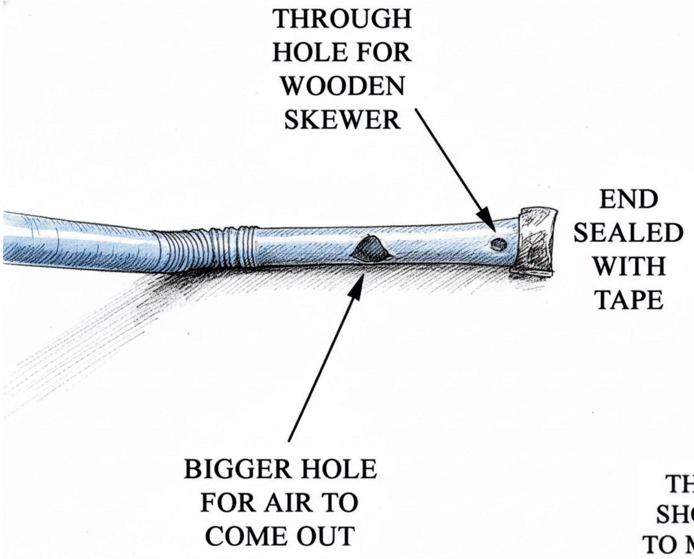


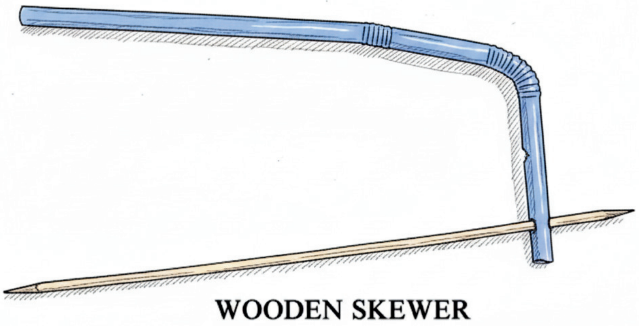
13. FLOATING CARD PROPELLER


Materials
BENDABLE STRAW
WOODEN SKEWER
RUBBER
CARD PROPELLOR
CYCLE VALVE TUBE
STIFF STRAW PIECE
CELLO-TAPE

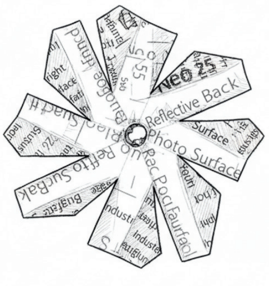

SEAL THIS END WITH CELLO TAPE

TAPE THE SHORT END OF THE STRAW

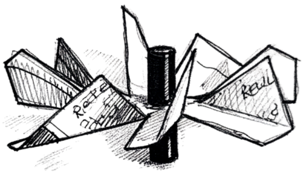

THROUGH HOLE FOR WOODEN SKEWER
END SEALED WITH TAPE
BIGGER HOLE FOR AIR TO COME OUT


WOODEN SKEWER

PRESS FIT WOODEN SKEWER IN THE SMALL HOLE NEAR THE SEALED END OF STRAW.

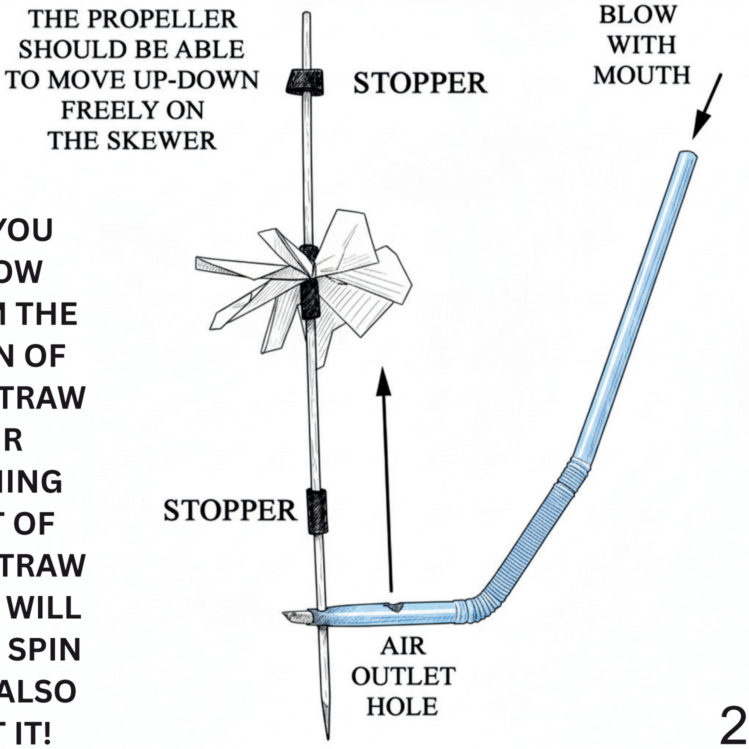


STIFF CARD PROPELLER WITH 8 VANES



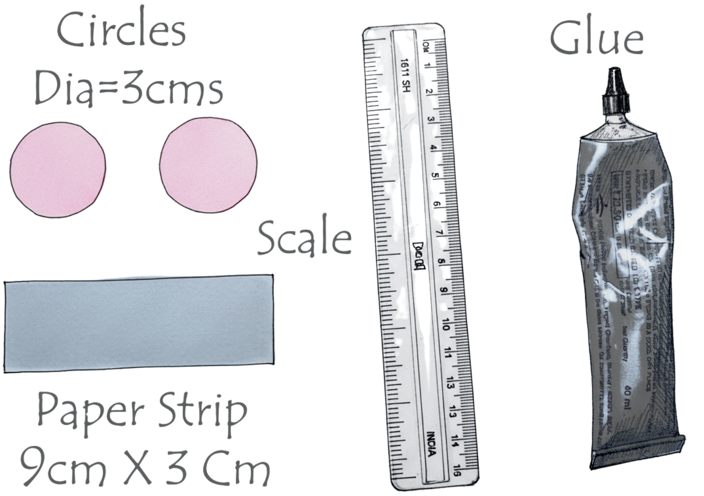
PRESS FIT STIFF PLASTIC STRAW IN THE CENTER OF THE PROPELLER

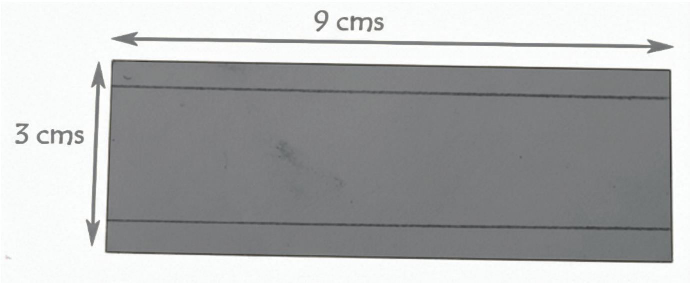
AS YOU BLOW FROM THE OPEN OF THE STRAW AIR COMING OUT OF THE STRAW HOLE WILL BOTH SPIN AND ALSO LIFT IT!


THE PROPELLER SHOULD BE ABLE TO MOVE UP-DOWN FREELY ON THE SKEWER
STOPPER
BLOW WITH MOUTH
STOPPER
AIR OUTLET HOLE

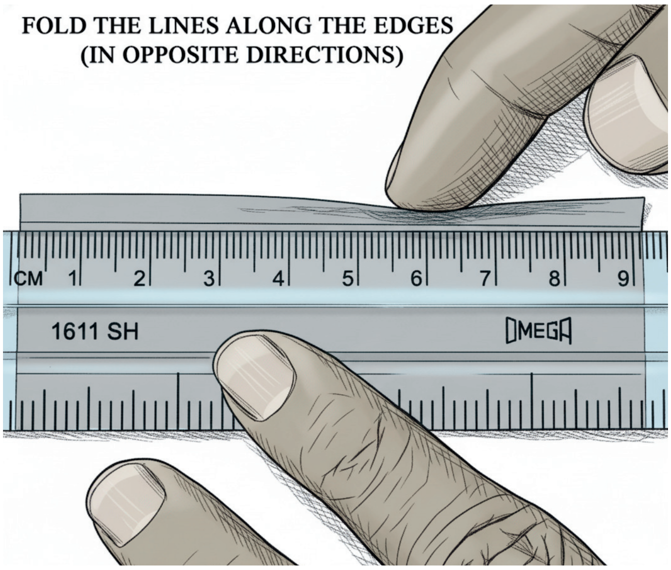
14. FLYING TUMBLER

Materials


Circles
Dia=3cms
Scale
Glue
Paper Strip
9cm X 3 Cm

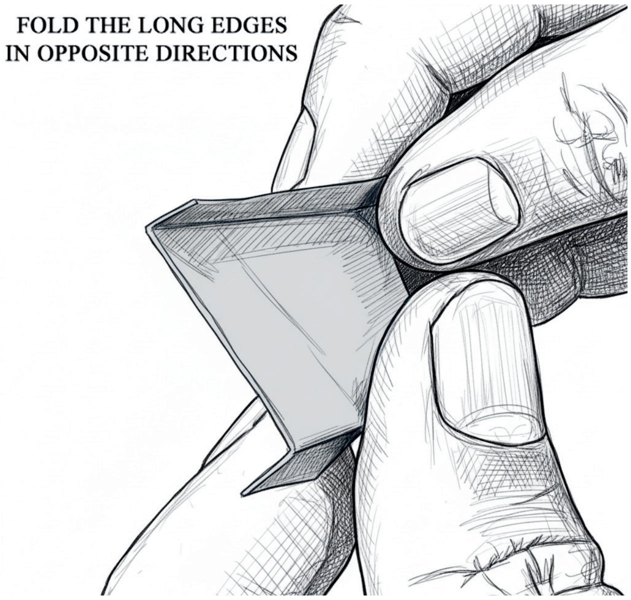


TAKE A STRIP OF PAPER
9-CM LONG & 3-CM WIDE
MARK LINES ALONG THE LONG EDGES

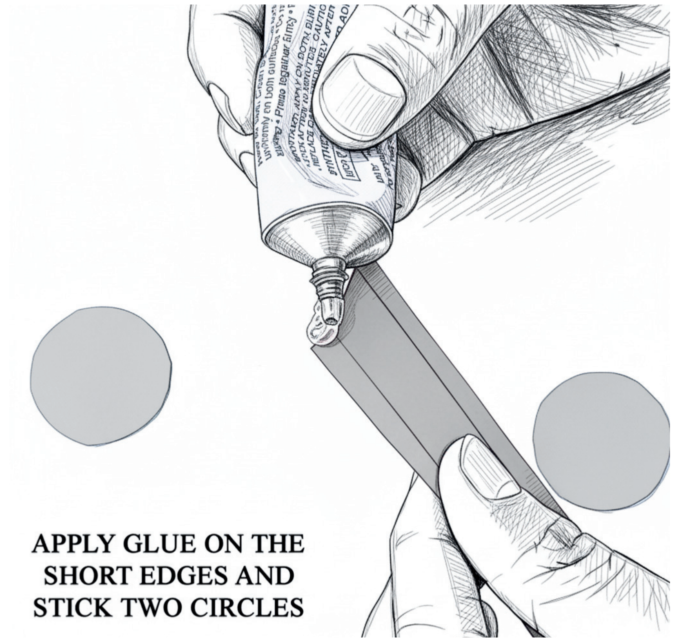


FOLD THE LINES ALONG THE EDGES
(IN OPPOSITE DIRECTIONS)

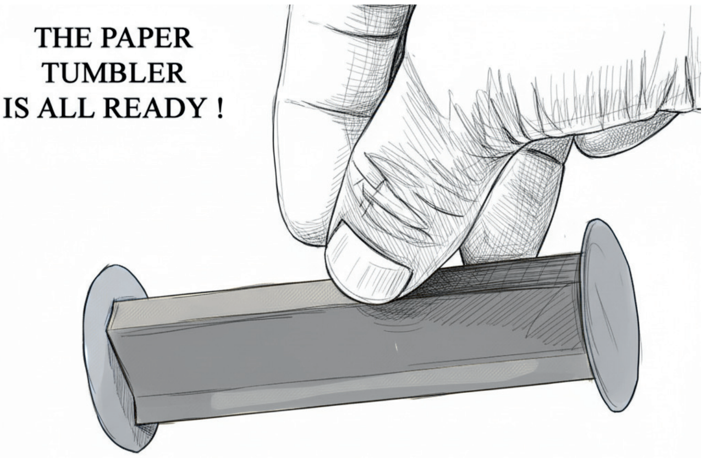
CM 1 2 3 4 5 6 7 8 9
1611 SH
OMEGA



FOLD THE LONG EDGES
IN OPPOSITE DIRECTIONS



APPLY GLUE ON THE
SHORT EDGES AND
STICK TWO CIRCLES

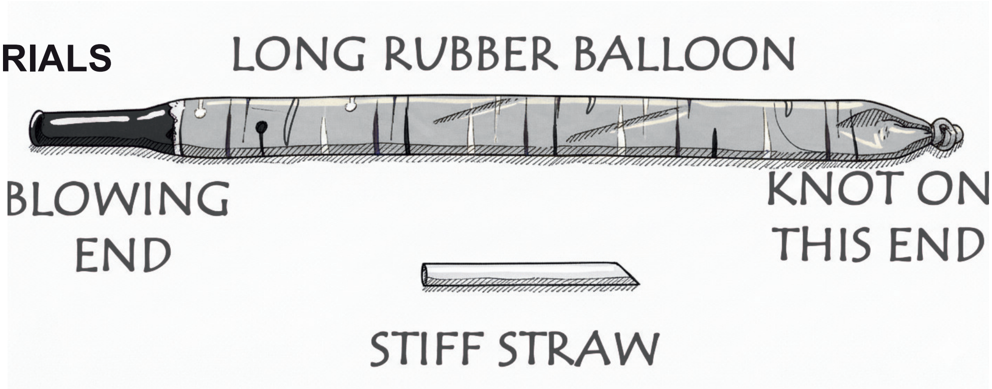


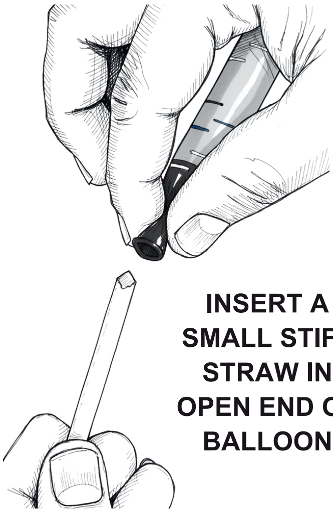
THE PAPER
TUMBLER
IS ALL READY !

ON THROWING IT FROM A HEIGHT
THE TUMBLER WILL COME
TUMBLING DOWN

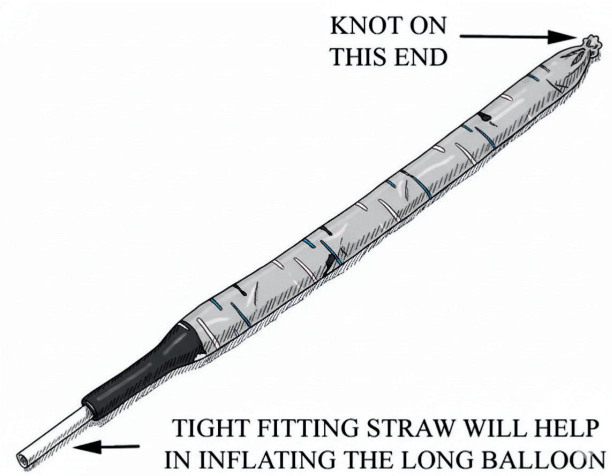
15. ROCKET BALLOON

MATERIALS

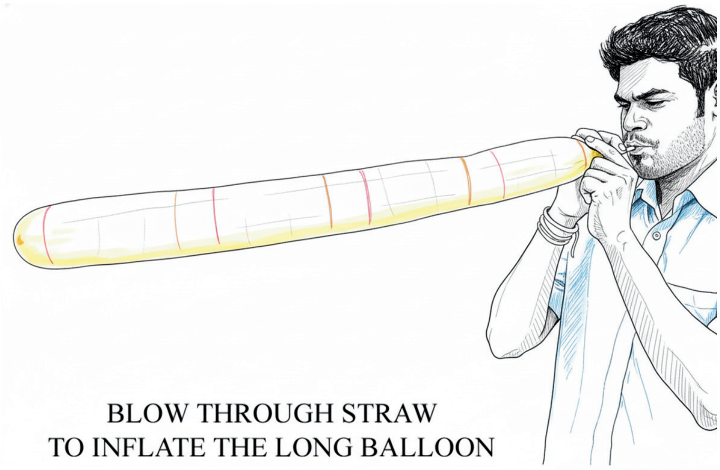

LONG RUBBER BALLOON
BLOWING END
KNOT ON THIS END
STIFF STRAW



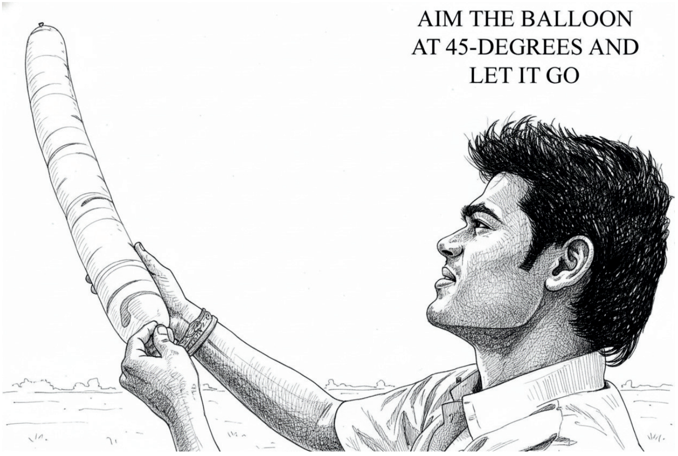
INSERT A SMALL STIFF STRAW IN OPEN END OF BALLOON


KNOT ON THIS END

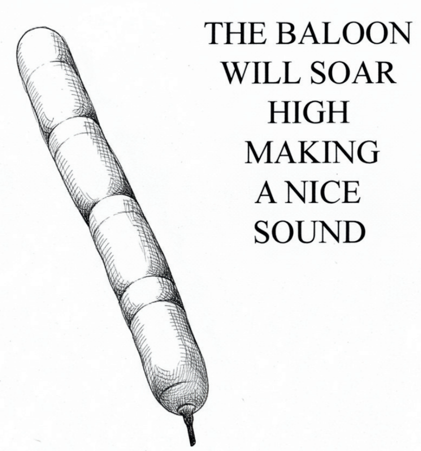
TIGHT FITTING STRAW WILL HELP IN INFLATING THE LONG BALLOON



BLOW THROUGH STRAW
TO INFLATE THE LONG BALLOON

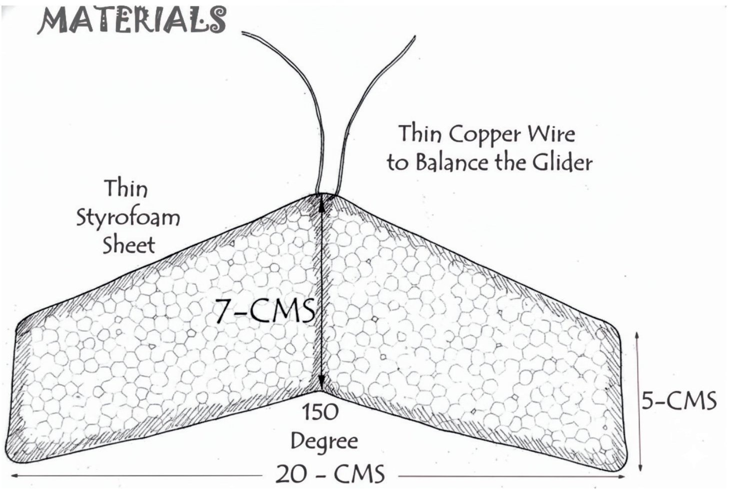


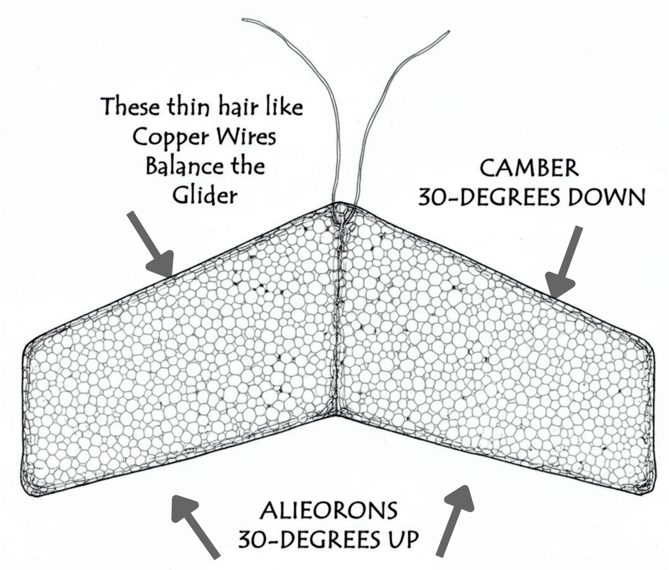
AIM THE BALLOON AT 45-DEGREES AND LET IT GO

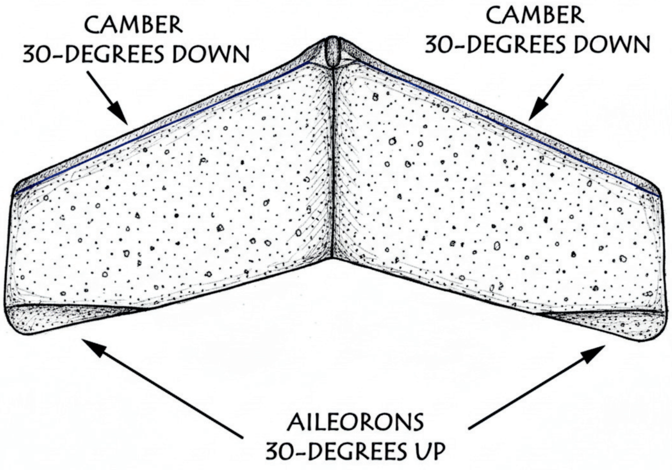


THE BALOON WILL SOAR HIGH MAKING A NICE SOUND

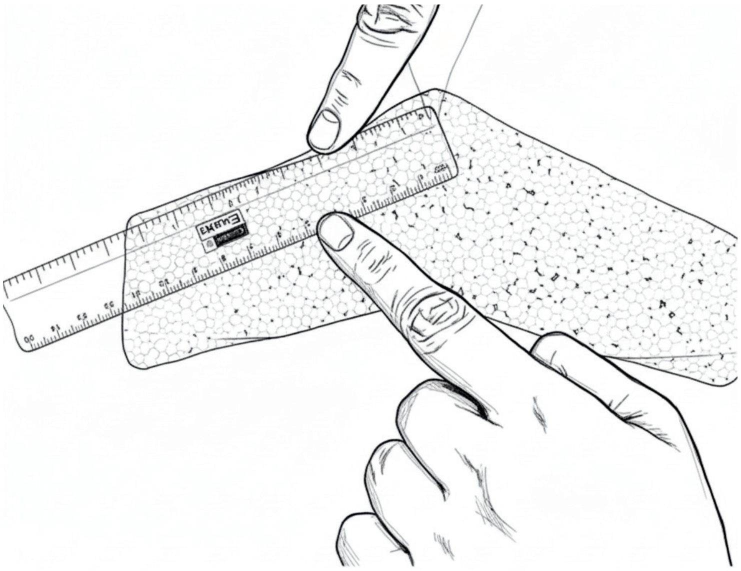
16. STYROFOAM GLIDER


MATERIALS
Thin Copper Wire
to Balance the Glider
Thin
Styrofoam
Sheet
7-CMS
150
Degree
5-CMS
20 - CMS

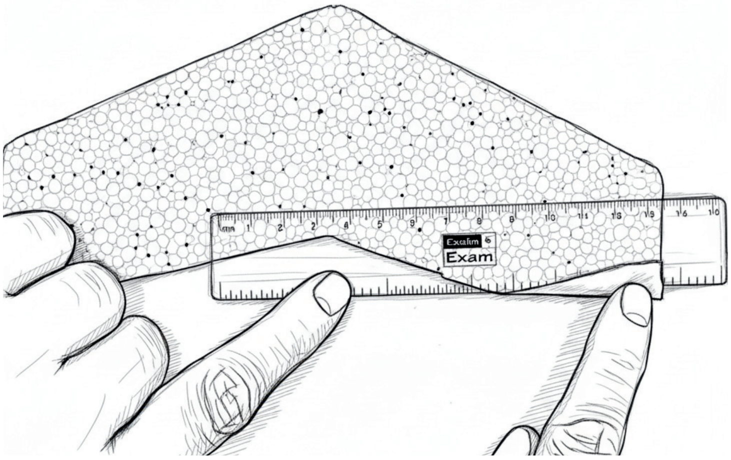

These thin hair like
Copper Wires
Balance the
Glider
CAMBER
30-DEGREES DOWN
ALIEORONS
30-DEGREES UP

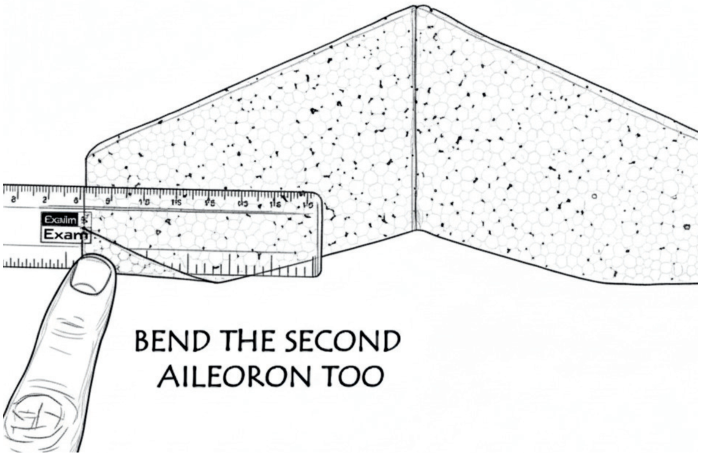

CAMBER
30-DEGREES DOWN
CAMBER
30-DEGREES DOWN
AILEORONS
30-DEGREES UP

BEND BOTH AILEORONS DOWN 30-DEGREES
WITH THE HELP OF A SCALE

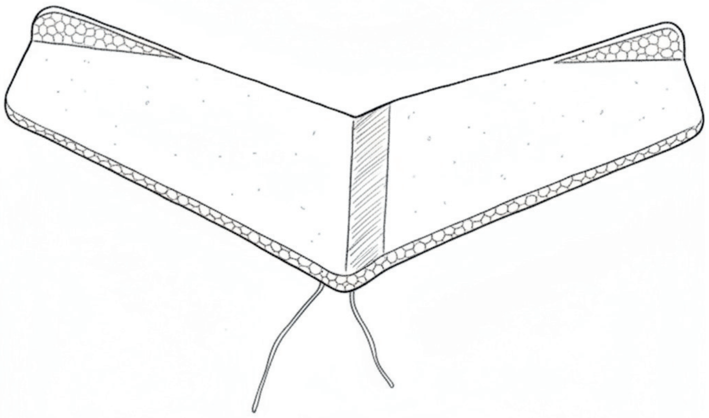


BEND CAMBER LINES AT 30-DEGREES WITH A SCALE

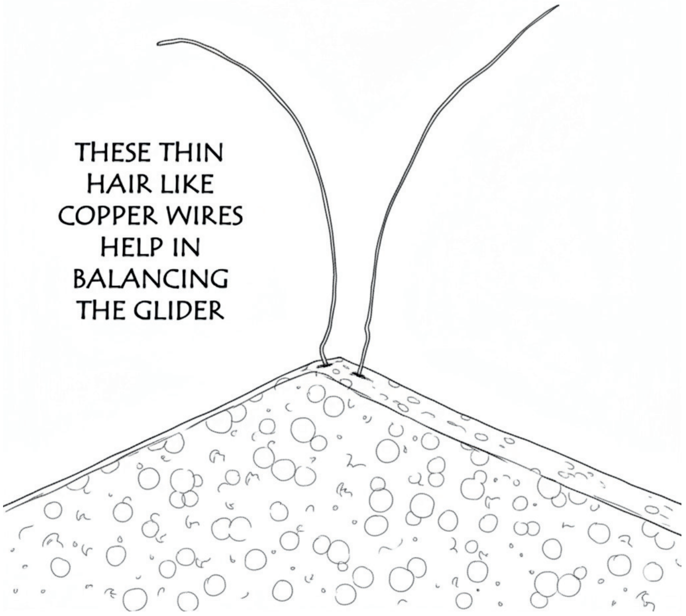

Exalim
Exam


Exalim
Exam

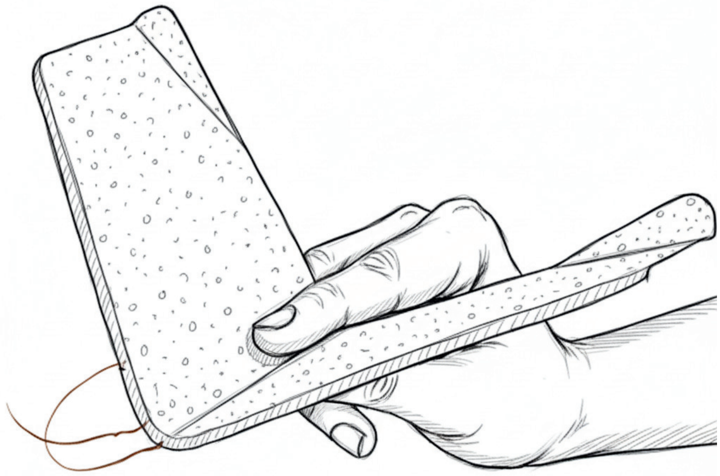
BEND THE SECOND
AILEORON TOO



BEND BOTH WINGS OF THE GLIDER
ALONG ITS MIDLINE AS SHOWN.
NOW THE GLIDER IS READY TO FLY.

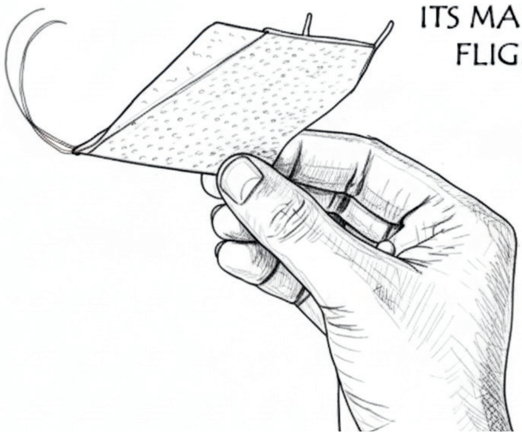


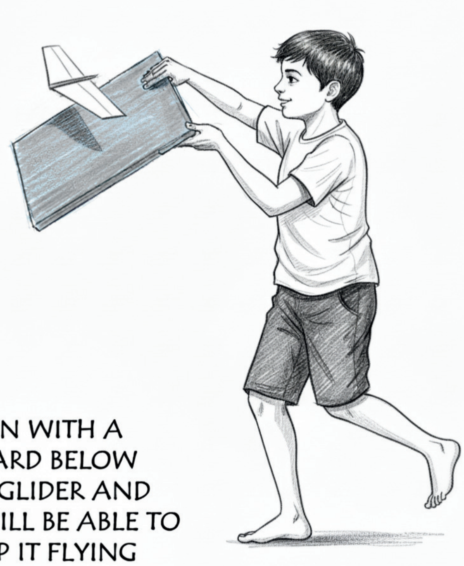
THESE THIN
HAIR LIKE
COPPER WIRES
HELP IN
BALANCING
THE GLIDER



HOLD THE GLIDER AS SHOWN
AND CHUCK IT FORWARDS

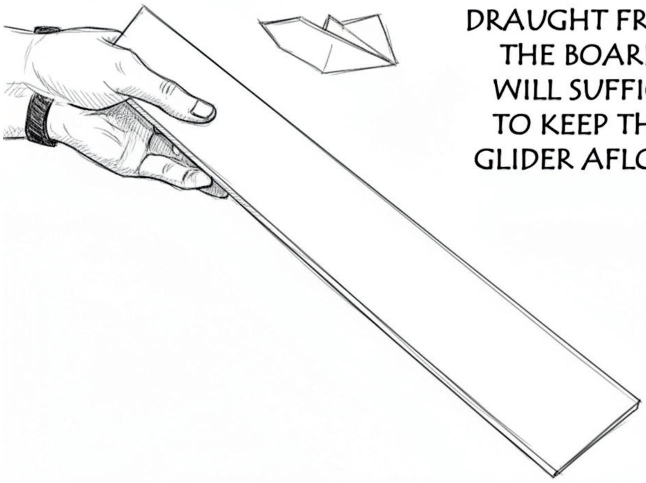
HOLD AS SHOWN
AND CHUCK
THE GLIDER ON
ITS MAIDEN
FLIGHT



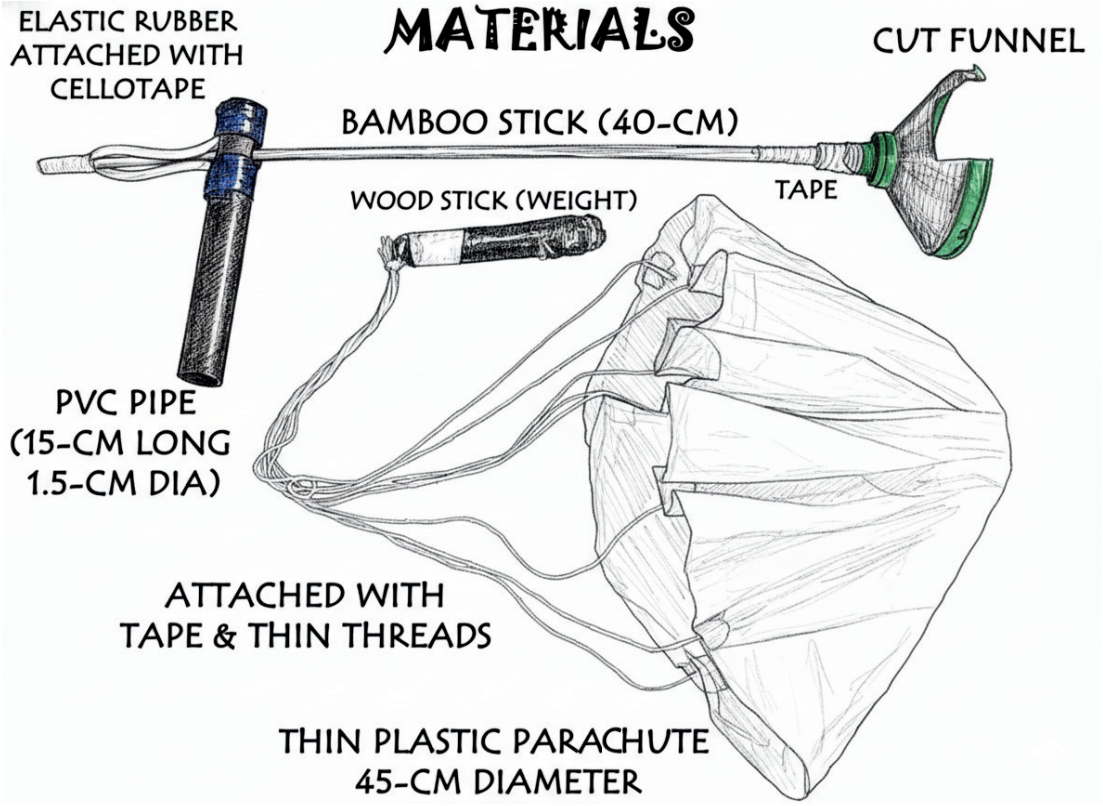


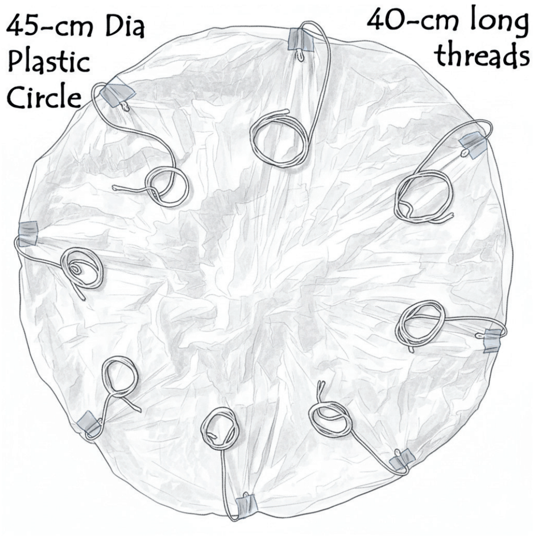
RUN WITH A
BOARD BELOW
THE GLIDER AND
YOU WILL BE ABLE TO
KEEP IT FLYING
FOR A LONG TIME

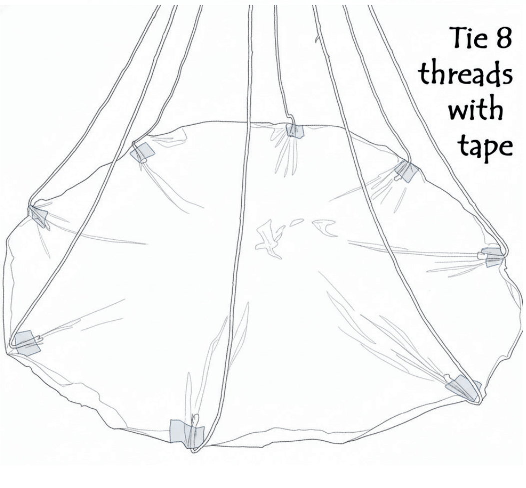
THE LITTLE AIR
DRAUGHT FROM
THE BOARD
WILL SUFFICE
TO KEEP THE
GLIDER AFLOAT

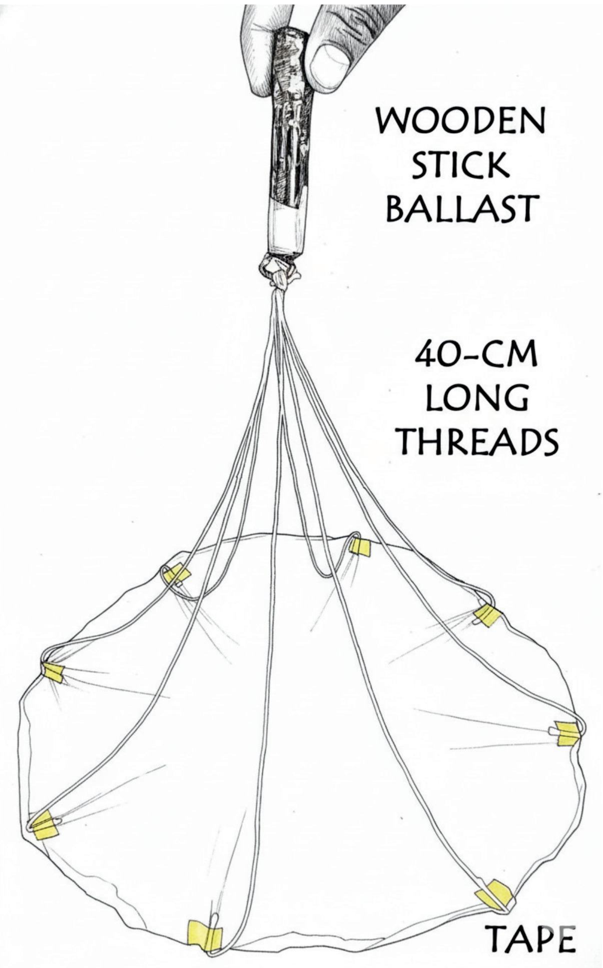


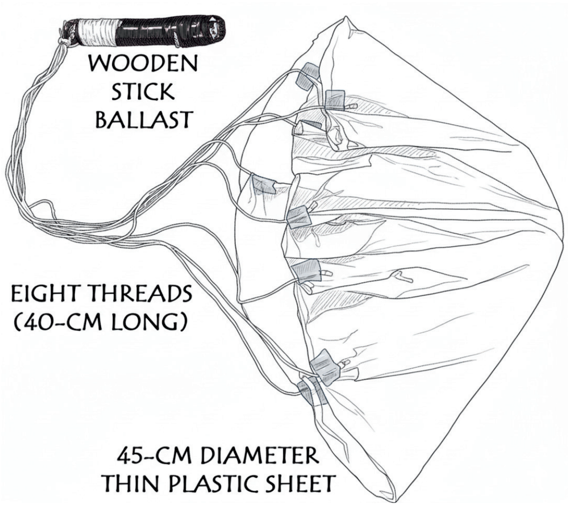
17. CATAPULT PARACHUTE

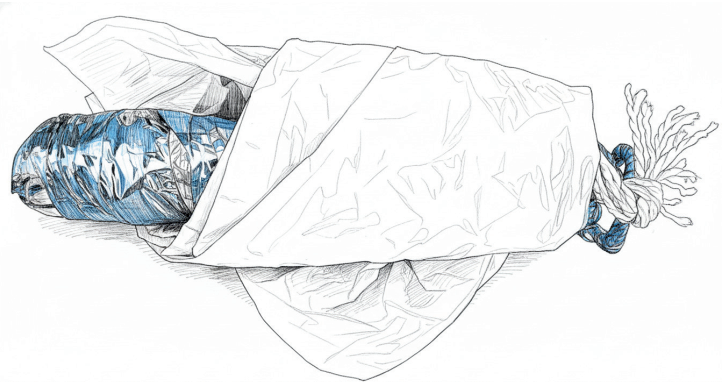

MATERIALS
ELASTIC RUBBER ATTACHED WITH CELLOTAPE
CUT FUNNEL
BAMBOO STICK (40-CM)
TAPE
WOOD STICK (WEIGHT)
PVC PIPE (15-CM LONG 1.5-CM DIA)
ATTACHED WITH TAPE & THIN THREADS
THIN PLASTIC PARACHUTE 45-CM DIAMETER


45-cm Dia Plastic Circle
40-cm long threads


Tie 8 threads with tape


WOODEN STICK BALLAST
40-CM LONG THREADS
TAPE

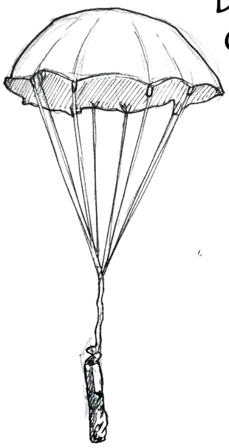

WOODEN STICK BALLAST
EIGHT THREADS (40-CM LONG)
45-CM DIAMETER THIN PLASTIC SHEET

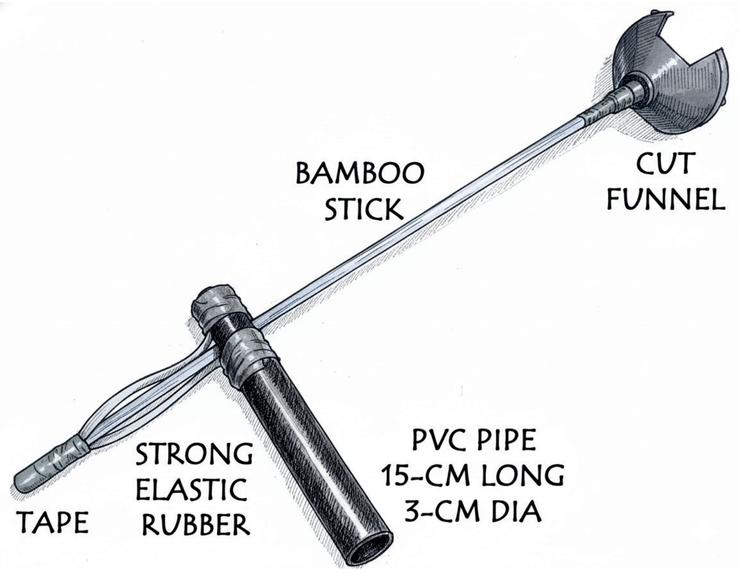


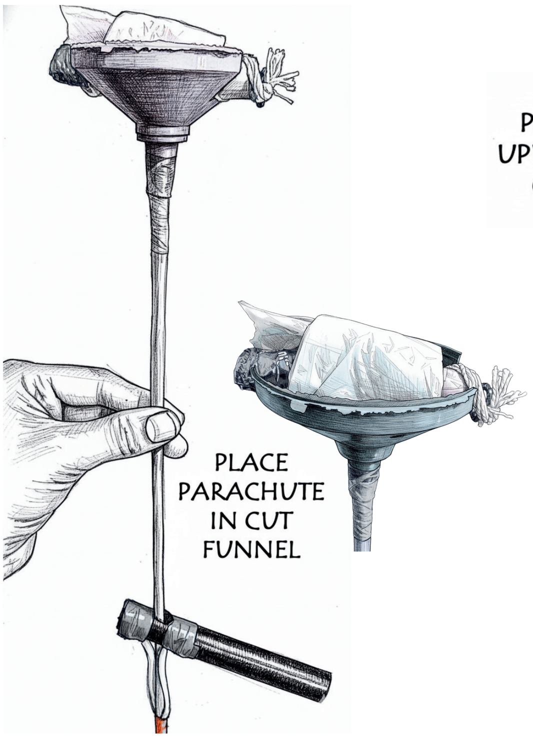
WRAP PLASTIC PARACHUTE WITH THREADS ON WOODEN STICKS

WHEN YOU THROW UPWARDS

PARACHUTE WILL DESCEND GENTLY

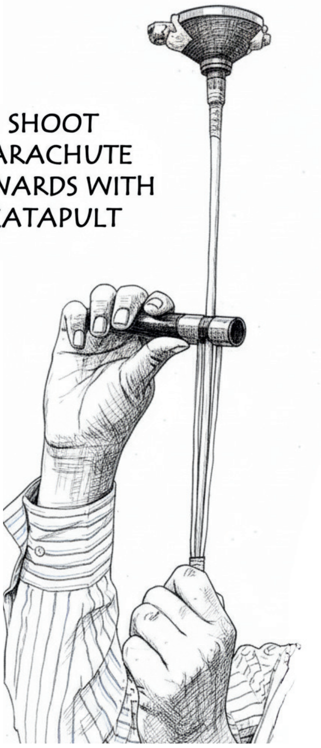


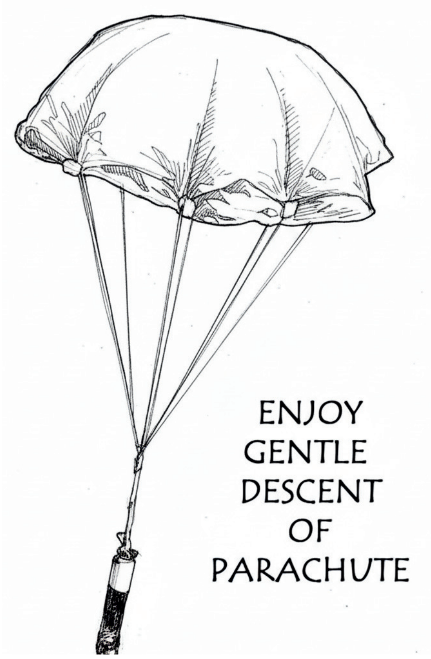

BAMBOO STICK
CUT FUNNEL
TAPE
STRONG ELASTIC RUBBER
PVC PIPE 15-CM LONG 3-CM DIA



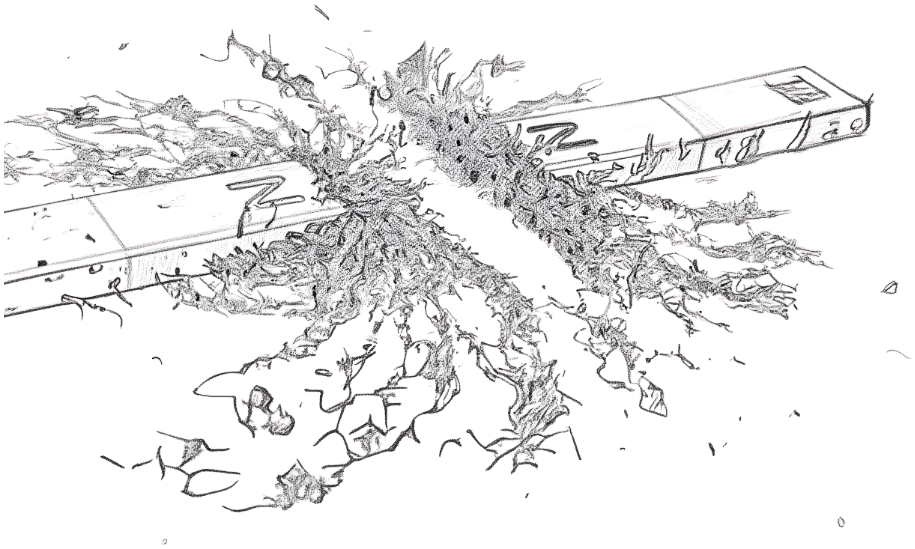
PLACE PARACHUTE IN CUT FUNNEL

SHOOT PARACHUTE UPWARDS WITH CATAPULT





ENJOY GENTLE DESCENT OF PARACHUTE



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